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A STUDY OF JOINT TUBERCULOSIS

WITH AN ORIGINAL THEORY AS TO ITS LOCALIZATION, AND WITH A NEW PLAN OF OPERATION BASED ON THE PATHOLOGY

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THE treatment of joint tuberculosis at the present day is almost entirely empirical. The widest differences of opinion exist as to the interpretation of the phenomena of the disease, and few facts have been established beyond peradventure. As in other cases, so in this the diversity in the last analysis depends upon ignorance. We are ignorant of many of the fundamental facts that would enable us to reason to a logical conclusion, and we have tried to substitute clinical experience for exact knowledge, to reason back, so to speak, from effects to causes, and to regard what we believe as what we know. The study of the pathology of bone and joint tuberculosis seems to have been comparatively neglected. With a few notable exceptions, those who have written on the disease have confined their attention to its clinical side. In the hope of adding, however humbly, to the fund of knowledge, this study has been undertaken.

Our method of procedure has been as follows: When a joint or portion of a joint came into our possession we submitted it to a thorough examination, both macroscopical and microscopical, cutting sections from the bones and soft parts, and noted down our findings. We then made an abstract of the patient's history as taken in the hospital, and of the operation that had been performed, and where possible followed the patient after his discharge and observed his further progress. This last was difficult, and often unsatisfactory. In many cases the last word had been spoken when the discharge from the hospital was signed.

The specimens at our disposal are sixty-two in number, removed from fifty-five patients. From four of these patients two specimens were removed from the same joint at different times; from three others the second specimen was removed from another joint. They are divided as follows: of the knee, twenty-seven;

Fig. 1. Bone tuberculosis. Drawing of bony trabeculæ undergoing rarefying osteitis. (Zeiss, objective C.) The section is taken from the side of a necrotic bone cavity. Observe the giant cells (osteoclasts) and the osteoblasts. The marrow is not drawn in the picture.

Fig. 2. Bone tuberculosis. Water-color drawing. Low power. Observe the tuberculous granulation tissue in the marrow bursting through the cartilage. No evidence is present of any "layers of fibrin" upon the cartilage, although the cartilage has been perforated. Sections of the synovial membrane failed to show any tuberculosis.

Fig. 3. Synovial tuberculosis. Low power picture showing marked hypertrophy of the synovia with extensive tuberculous involvement. At one spot may be seen a thickened artery. The superficial parts are necrotic. Granulation tissue is spreading under the cartilage, interfering with its nutrition, and at one spot starting to break through.

Fig. 4. Bone tuberculosis. Low power picture showing granulation tissue in the marrow and two areas of necrosis. The cartilage has been loosened by interference with its nutrition from beneath, but there is no evidence of any "layers of fibrin" on its surface. Water-color drawing.

Fig. 5. So-called bone tuberculosis. This water-color picture shows the typical tuberculous myelitis as seen under low power. Two areas of necrosis are present and several giant cells. The bone structure itself escapes.

M.M. Old healed knee-joint tuberculosis in a child. Bony union following secondary infection and prolonged suppuration. X-ray taken in 1909 at the age of about 13.

of the ankle and tarsus, eight; of the hip, seven; of the elbow, seven; of the wrist, six; of the shoulder, three; and of the fingers and toes, one each. Besides these we have a specimen from the humerus and one from the tibia in which the joint was not involved. Thirty-seven male patients contributed forty-two specimens; fourteen females contributed sixteen joints; and in four cases the sex was not mentioned. In addition to our clinical material we have injected eight joints in three dogs with a pure culture of the tubercle bacillus. The surgeons to whose courtesy we are indebted for our material are sixteen in number, and in view of what we are about to say it seems well to emphasize the fact that they represent a high order of ability.

Before beginning the discussion of the specimens themselves, we wish to call attention to the remarkable frequency of errors in diagnosis. In two cases the clinical diagnosis was not given; in thirty-nine tuberculous joints it agreed with the final laboratory findings; in six the laboratory diagnosis was tuberculosis, and the clinical, no tuberculosis or doubtful. In fifteen cases of joints operated on as tuberculous or without definite diagnosis, tuberculosis was not found in the laboratory. This gives us 65 per cent of correct diagnoses, and when we consider that several of these were assisted by a previous pathological examination, the unreliability of the clinical diagnosis alone is even more apparent. In each case we have taken as the clinical diagnosis that made by the operator. In those cases where we have noted the various diagnoses of different men on the same joint, the results were even more startling. So disquieting were they, indeed, that we submitted the specimens to a second thorough examination, endeavoring to modify our conclusions, and to find traces of tuberculosis where we had found none before. The second examination did not change the results of the first; and the cases clinically non-tuberculous, in which tuberculous tissue had been found, admitted of no change.

Now, it may be argued that tuberculosis may exist in a joint and may escape detection in the laboratory, and that if a joint is clinically tuberculous, it is tuberculous in spite of what it shows under the microscope; but to this the answer, of course, is that all our clinical classification as well as our definition has been built up on laboratory findings, and that unless tuberculosis can be demonstrated under the microscope the joint is not tuberculous. If no microscopic examination be done we simply call a joint tuberculous because of its clinical similarity to other joints in which the characteristic tubercle has been demonstrated under the microscope.

We will admit, however, that as the appropriate stains have not been used to detect the presence of the tubercle bacillus, there may be a small margin of error in our conclusions.

Not only in the matter of diagnosis have errors been found in the statements made in the histories. Notes taken at the time of operation are not always reliable. One opera-

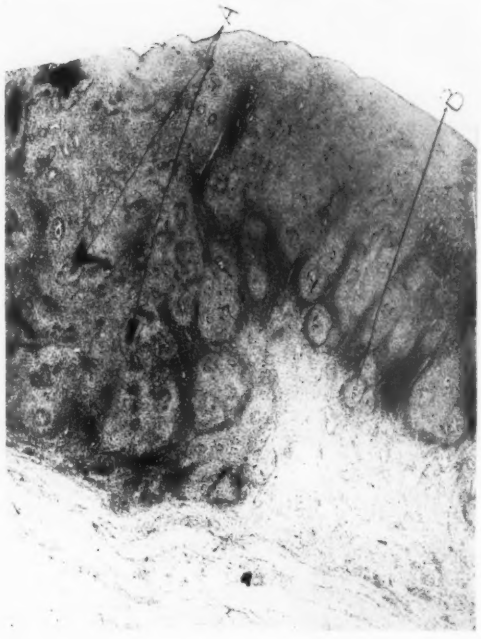
tor pronounced the bone soft and much "eaten away" because it broke in his lion-jawed forceps, but in the laboratory it proved to be quite hard. Another history gives the information that "scattered tuberculous foci" were found abundantly in the head of the bone. These "scattered tuberculous foci" were small, white particles of cartilage that had evidently been carried in on the saw, and no tuberculosis could be found in the specimen.

It may be well here to lay down a definition of the term "joint tuberculosis." It is the reaction of the tissues in and about a joint, or of some of them, to the presence of the tubercle bacilli and of their toxines. These can reach the joint in only one way, except in rare instances of direct infection from without the joint, and that is through the blood; and Müller produced the disease in animals by the injection of pure cultures into the nutrient arteries of bones. Parenthetically it may be said that those who have injected the joint itself with the bacilli have produced a tuberculous abscess in the joint, and thus have not exactly imitated nature's method. Whether in patients suffering with the disease, the bacilli are carried there primarily, or whether they are brought from some other focus in the body, is not always certain. In 20 per cent of König's cases no tuberculous lesion was discovered elsewhere. When the bacilli are deposited in the joint they give rise to the formation of the typical tubercle, and almost at this point we may take leave of theory, and trace the succeeding steps of the disease.

Pathology. Of the four essential structures of a joint, bone, cartilage, ligament, and synovial membrane, all connective tissue structures and all formed from the mesoblast, the first and the last offer the field for primary invasion. This view has been held for many years abroad, but in America, largely owing to the teachings of Nichols of Boston, the opinion has prevailed in recent years that all cases of joint tuberculosis originate in a bony focus. Nichols, basing his conclusion upon a study of more than one hundred and twenty specimens, wrote that even those cases which seemed to be primarily synovial, if examined carefully would show that the synovial disease was merely an extension from that of the bone.

M.M. Old healed knee-joint tuberculosis. X-ray taken in 1910. Observe the change in the bone structure at the old level of the joint — a condensation about the periphery and a prolongation of the medullary canal of the tibia upward.

This theory is attractive and makes for simplicity, but our observation does not tend to confirm it. In the first place, primary synovial tuberculosis is found in tendon sheaths, which differ in no essential from the synoviæ of joints. In the second place, a careful examination of our specimens fails to reveal in a number of them any bone involvement whatever, and in many of them any signs of a bony focus. Third, there seems to be a difference, more or less plainly marked, in the clinical behavior of synovial cases and of those of bony origin. Again, in many cases in which the bone and synovial membrane are both involved, the damage to the bone is so insignificant and that to the synovia so extensive, that it seems impossible for the disease to have started in the former and spread to the latter



303 B. Synovial tuberculosis. Section from synovial membrane showing typical tuberculosis. X about 20 diameters. A, Areas of necrosis. B, Giant cells.

with so little damage to the original host. We quote three cases for illustration. A woman patient with extensive pulmonary tuberculosis underwent in Roosevelt Hospital an excision of her tuberculous right ankle. Shortly after, her leg was amputated on account of secondary infection. No mention was made in her history of any disease of the other leg. She was discharged cured from the hospital, and returned in six weeks with a typical tuberculosis of her left knee. This was resected, and showed in the laboratory very extensive disease of the synovia, but no bone involvement. For the process to have originated in bone after her discharge and then to have spread throughout the synovia, is improbable, while that a bony focus in her left knee could have existed during her first stay and could have escaped attention seems even less likely to one acquainted with the symptoms attendant on bone disease. Another patient, under the writer's conservative treatment for five years, at length consented to a resection of his knee. The bones showed no tuberculous disease, but the synovial membrane was involved. Another patient gave a history of seven years duration, with very slight symptoms of pain and disability. He had a moderate amount of fluid in his joint and slight limitation of motion, but no circumarticular thickening, and little if any, muscular atrophy. An exploratory incision was made into the joint and several tabs hanging from the synovial membrane were snipped off. The cartilages appeared smooth. A laboratory examination of the material taken out revealed typical tuberculosis. An excision done two months later showed that the cartilages, smooth before, had begun to be eroded, but no tuberculous tissue could be found in the bone. Collections of cheesy material were scattered through the synovia. Other cases could also be quoted.

To prove absolutely in any case that a minute bony focus might not be present would be an exceedingly difficult matter, but, given the occurrence of primary synovial disease in tendon sheaths, the failure to find a bony focus by a careful examination in a number of joints in which the synovia is extensively diseased may be accepted as conclusive.

We shall take up first the cases beginning in a so-called bone focus, and, inasmuch as in the knee the disease can best be observed, it is the custom of writers on this subject to take this joint as typical. We shall follow this custom the more readily, as most of our specimens are from the knee.

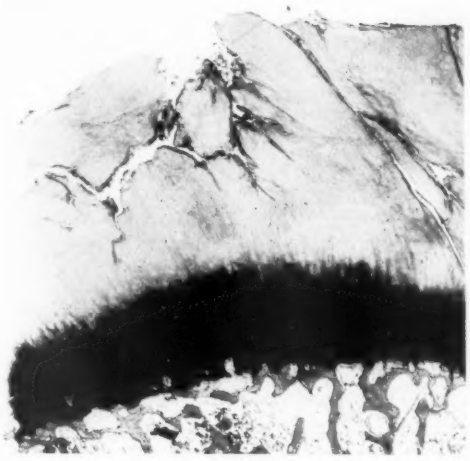
The primary tubercle is formed in the marrow of the epiphysis of one of the long bones (or of the patella), and, as in other organs of the body, the tuberculous inflammation spreads at the periphery, with the formation of other tubercles and their coalescence, and a tendency to break down at the center and to become necrotic. The granulation tissue thrown out around the tubercles in the effort of repair may also become invaded, or it may be converted into fibrous tissue and form a capsule more or less complete. In some of our specimens the division of the tuberculous tissue by fibrous septa is well marked. A study of these joints teaches the impracticability of the attempt to divide the disease into stages, or

periods of active invasion and repair. It does not advance to a certain point and then recover, but almost invariably invasion and repair are going on together, sometimes at the same part of a joint, sometimes in different parts. The tuberculous granulations advance in the marrow, and, surrounding the trabeculæ, shut off their nutrition and kill them, either en masse, with the formation of a sequestrum, or in small particles, giving the "bone sand" so characteristic of the disease. Often the trabeculæ can be seen under the microscope to be undergoing rarefying osteitis. Sometimes they may be seen to be lying dead, surrounded by pus cells.

The further details of this pathological process involved in the spread of the typical tuberculous tissue, its characteristics, its shape, etc., have been so often described and seem so well understood that it hardly seems wise to go into them here, further than to say that the attempt to describe the various shapes that the morbid process may have and to classify the cases on this basis seems futile. The use of the terms "caries sicca," "joint fungus," etc., seems also unwise, as indicating distinct morbid processes, whereas they are merely different forms of the same disease.

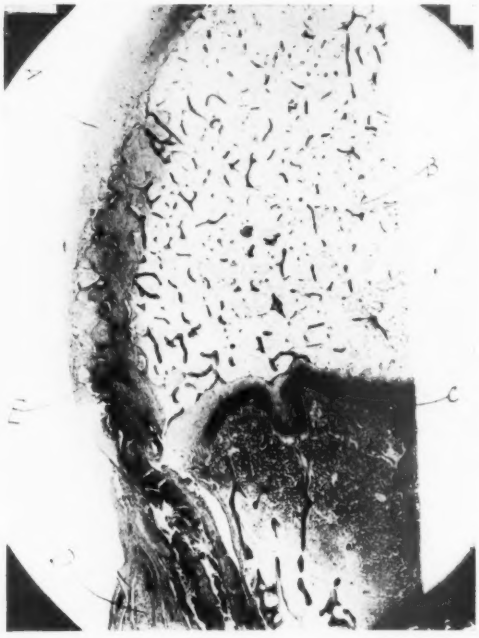
The bone in the vicinity may cut easily with a knife, or it may be much harder than normal. Often, at operation, drops of fat will follow the saw, so-called "fatty osteomalacia." Sometimes when the bone is cut for sections it will float in water.

The tuberculous tissue spreading in the marrow may find its way directly to the periosteum, and, breaking through this, may form an abscess in the surrounding tissues and so reach the surface without ever involving the joint; but in the great majority of cases the disease seems to seek the joint as if with a defined purpose. The cartilage offers a barrier to its progress, and when the tuberculous granulations reach it, one of three things happens, viz., 1, the cartilage, deprived of its nutrition, is perforated and so affords access to the joint; 2, the granulations spread out under the cartilage, mushroom, so to speak, and, shutting off the nutrition of a large area of it, lift it off in a leaf or flake, and thus reach the joint; or, 3, they may travel along under



303. Synovial tuberculosis. Section from patella showing fibrillation and fraying of articular cartilage. X 20 diameters. The cartilage has begun to degenerate, but no "layers of fibrin" are to be observed on its surface.

the cartilage and gain the joint at its side. During this process the joint may be the seat of a serous effusion. When it is once involved, the disease may spread rapidly through all its structures, and involve the synovial membrane and the other bones, or it may involve only parts of the joint and leave the rest almost normal. Frequently adhesions are formed as if in the effort to shut off the disease, similar to those in the peritoneal cavity or in the pleura; and sometimes sections from one region will show normal joint structure, while from another they show typical tuberculosis. Hence the unreliability of a section removed from a joint for diagnosis. Often one condyle and the opposing tuberosity will be badly involved, while the other condyle and tuberosity are practically sound. The further course of the disease now will depend on the relative production of fibrous tissue and of soft granulation tissue and serum. If the fibrous tissue predominate, the tuberculous granulations are slowly encapsulated as they form and spread, and the joint becomes in whole or in part a mass of fibrous adhesions which deprive it almost entirely of motion. If the soft granulations be not organized, white corpuscles and serum are added to the liquefying mass and a



1117. Bone tuberculosis, showing spread of the tuberculous process under the periosteum and cartilage. Specimen from external condyle in 12-year-old child. Joint is not yet involved. X 8 diameters. A, Articular cartilage. B, Epiphysis. C, Epiphyseal line. D, Periosteum. E, Area of tuberculosis.

cold abscess is formed which, breaking through the capsule, escapes into the surrounding tissues, and then, becoming secondarily infected with pus germs, gains the surface and discharges its contents.

Clinical experience teaches that in children the process may be halted at almost any stage, and the joint may recover with a fair range of motion. In some cases complete bony ankylosis takes place. In adults, we believe, neither of these results is ever obtained, and cure is always brought about by fibrous encapsulation and is never complete.

In the cases with a synovial origin, the primary tubercle is deposited in the membrane itself, not, as König teaches, by the infection of the surface layers from a "tuberculous exudate" in the joint cavity. The synovia may be badly diseased and still have a smooth, healthy looking surface. In our opinion the start is usually in the folds or fringes found in the recesses of the joint, and the disease may remain more or less localized, or it may spread throughout the entire joint, with or without involvement of the bone. The fringes and villi become thickened and enlarged, and the entire membrane may also be much thicker than normal. One of our cases was characterized by the formation of pedunculated bodies hanging in the joint (lipoma arborescens), varying from the size of a pea to that of a large lima bean, and in the largest of these bodies a spot of calcification was revealed on section. Tubercles may often be seen by the naked eye studding the synovia, and scattered through its substance. The folds of the membrane may be so hypertrophied as almost to hide the articular cartilage. They seem to be adherent, but usually are found to be merely lying upon it. In joints that have been long diseased the synovia may have almost disappeared, *leaving little else than fibrous tissue.* Under the microscope the typical tubercles are seen, often with areas of necrosis.

The frequency of obliterating endarteritis has not been appreciated. It was present in the majority of our specimens to a marked degree. Sometimes the production of fibrous tissue is well marked in the diseased area, sometimes one finds abundant new granulation tissue in the membrane or upon it. The layers of fibrin emphasized by König are not often present. In none of our joints have we seen the "rice bodies" described by others. It is necessary for a thorough examination of these joints that sections be made from many parts of them; otherwise one's conclusions are liable to error. In one of our specimens, diagnosed before operation as tuberculous arthritis of the ankle, a laboratory diagnosis had been made of "chronic inflammation; no tuberculosis." The entire joint was a mass of fibrous adhesions, but in one recess was at length found a small cheesy nodule, which under the microscope was seen to be an old encapsulated cheesy tubercle.

We have seen that while the bone is being destroyed by the growth of the tuberculous tissue in its meshes, that is, in the marrow, the bony structure itself is never invaded, but is simply killed by the interference with its nu-

trition. Much the same may be said of the ligaments and cartilages. The behavior of the cartilage is especially interesting and has been the subject of much discussion. König attached great importance to the precipitation of layers of fibrin from the joint exudate upon the cartilage, and to their subsequent organization and tuberculous infiltration. This "tuberculous pannus" extending in from the margin then was supposed to play a great part in the subsequent erosion and destruction of the cartilage. In fact, the role accorded by König to the exudate in the joint is the principal one in synovial disease, and through it in the cases with bony focus he thinks that the synovia is affected. He traces his pathology of the entire joint from the formation of the exudate. In this we think that he and his followers are in error. We regard the exudate as a mere symptom, and think that it plays a very small part in the extension. In a few of our specimens layers of fibrin have been observed on the cartilage and on the synovial membrane, but generally they appear to be an effect and not a cause. The older anatomists used to describe the synovial membrane as a pouch — instead of a tube — running over the cartilages, but their view has been abandoned. The synovia runs a short distance out on the surface of the cartilage, and both at the surface and deeper in, the structure of the one gradually shades off into that of the other. The transition from the branching connective tissue cells of the synovia to the true cartilage cells is also a gradual one. In other words, there is no essential difference in the basic structures of the two tissues, and recent writers[1] say that immobilization causes the synovia to encroach upon the cartilage and to spread out over its surface, only to recede again when motion has been resumed. Lack of function causes a tendency in the cartilage to revert to fibrous tissue. We find as one of the early evidences of the degeneration of the cartilage in tuberculous disease, an exaggeration of this phenomenon, an encroachment of the synovia and a distinct fibrillation of the cartilage itself. In the deeper portion the direction of the fibers is perpendicular to the surface, but more

[1] Nathan: Journal of the Am. Orthop. Assn., August, 1909; quoting Reyer, Fisher, Hammer, and Braun.

Bone tuberculosis. Upper end of tibia. Joint not involved. X-ray picture showing two sequestra. This case was variously diagnosed as tuberculosis, syphilis, and old osteomyelitis. A microscopical examination of the tissue removed showed typical tuberculosis. The black smear is mercurial ointment.

superficially the fibers run parallel to it, and in places are frayed out, with their free ends waving loose. These frayed ends, in our opinion, must have been mistaken for deposits of fibrin. The transition from the fibers to the homogeneous cartilage structure is often so gradual that one can not tell where the one ends and the other begins.

Sometimes this fibrillation seems to be the only evidence of the degeneration. Sometimes the cartilage is more or less broken up, as if the tuberculous tissue beneath were bursting through it, and holes can be seen in it, filled with inflammatory tissue. In some of our sections the cartilage at the sides is fibrillated, further in it is broken up, and still further its structure is blurred. Occasionally we find a layer of inflammatory tissue lying on the surface, but tuberculous tissue in this situation is very rare. We conclude from a study of our specimens that no serious damage is ever

924. Tuberculosis of the metacarpo-phalangeal joint, synovial type. The tuberculosis spreading from synovial membrane has attacked the bone at its articular surface. X about 10 diameters. Section from phalanx.

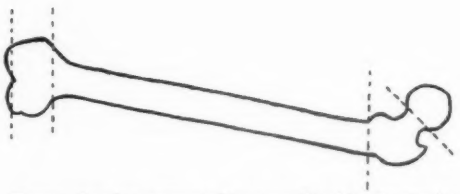
wrought to the joint cartilage in tuberculous disease except that which is done indirectly by the involvement of the bone marrow beneath it.

Upon opening a tuberculous joint we may find the cartilages smooth and apparently normal, especially in synovial disease in its early stages — sometimes also in its later course — but as a rule in synovial disease an erosion will take place beginning at the sides of the cartilage and spreading inward. In bone disease the cartilage over the affected bone is mottled, thinned, and more or less eroded in spots. Sometimes, on the other hand, the smooth cartilage will give no idea of the extensive bone disease beneath it.

Through all our specimens the entire pathological process can be translated as nature's effort to abolish function, to deprive the joint of motion, and, as we have mentioned, this is never successful in adult joints. In them the ankylosis is always fibrous, and, therefore, motion is always possible. This attempt to abolish motion in the joint is suggestive. We regarded it as nature's effort at cure, and in our earlier work were wont to ascribe to motion in a joint the causative role in joint tuberculosis. Further study convinced us that while our theory contained a germ of the truth, it could not cover all the phenomena of bone tuberculosis, and that some other cause must be sought. We found this in the histological structure of the joint tissues.

The bone structure itself, the trabecula, is never involved in the tuberculous process either early or late. It, as well as the cartilages and ligaments, escapes tuberculous invasion, and, like them, suffers only by interference with its nutrition. All three play a passive role in the disease. Virchow's original definition of a tubercle confined it in its occurrence to connective tissue, but there must be some peculiar element in the connective tissue that renders it liable to invasion. Not all connective tissue is vulnerable. Primary involvement of pure fibrous connective tissue is very rare, if it ever occurs. Bone structure proper in the last analysis is connective tissue plus lime salts, and cartilage a fibrous structure plus a cement substance. Many of our specimens show this fibrous structure clearly. The synovial membrane is also a connective tissue structure.

In bone tuberculosis, the only tissue that is affected directly by the disease is the marrow, and in the marrow the disease spreads, not in the ordinary yellow or fatty marrow found in the shafts of the long bones, but in the red marrow of their cancellated ends (as also in the red marrow of the vertebræ, the short bones, the sternum, the ribs, and the cranial diplœ) hence in the long bones *always in the vicinity of the joints*. Exactly what the character of the cells is that makes the red marrow a field for the spread of the disease, we do not know; but we assert that where this marrow is found in bone the bone is subject to tuberculous invasion; and where it is not found, there the bone is immune, or almost immune, to a purely tuberculous infection. Any operation that causes the epiphyses of the long bones to lose their cancellous structure and to become compact bone, that is, any operation that causes the marrow to change from the red or cellular variety to the yellow, will cause the disappear-



Femur, showing amount of bone sacrificed by the classical method of resection and by our method.

ance of the disease at that spot. Hitherto, many writers have called attention to this vulnerability of the epiphyses of the long bones, and have attempted to explain it on various hypotheses, but no explanation has ever been accepted as adequate. Some have said that it was due to the greater blood supply; but abundant blood supply is no cause for tuberculosis. Others claim that congestion following a strain or injury is the cause; but congestion (Bier treatment) is one method advanced for healing the disease, and all investigators[1] admit that severe injuries such as fractures and dislocations are not followed by joint tuberculosis. Others again would have us believe that there is some peculiar arrangement of the capillaries here. Our explanation is simple and comprehensive, and goes far to clear up many facts hitherto regarded as obscure.

Of the synovial membranes, classed among structures of the lymphatic system,[2] the smooth fibrous portions are probably not the ones liable to primary invasion, but rather the fringes in the recesses of the joint, where there is found a distinct epithelioid covering (Quain) or epithelium (Gray), and where the smaller, non-vascular, secondary fringes of Rainey (synovial villi) consist for the most part of small round cells with granular protoplasm. Throughout the body it is the connective tissue structures containing epithelial, epitheloid, or lymphoid cells that are prone to invasion by tuberculosis, *and the tissues of the joints are no exceptions to this rule.*

We say of the synovial membranes that any operation which deprives them absolutely of function causes them to lose their distinctive structure, and to change to fibrous connective tissue, and hence cures the tuberculous disease in them.

Let us see where all this leads, and how it agrees with the known facts of the disease.

In the first place, the beneficial results of rest in tuberculous joint disease have long been known. Now, rest means abolishing of function; and deprivation of function means the loss or partial loss of the characteristic structure of a tissue and its replacement by connective tissue of a low grade of organization. Consequently, rest means to the two elements of a joint liable to tuberculosis a loss of their peculiar cellular elements and consequently a withdrawal of the field for the spread of the disease. Pain is conservative, and unaided nature *rests* the joint by making motion painful. With apparatus or plaster-of-Paris or rest in bed we simply aid nature.

As a corollary to this it may be said that growing children are more active than adults, they use their joints more; consequently, they are more subject to joint tuberculosis than adults. Again, their bones contain more red marrow.

When we turn to the operative treatment of joint tuberculosis, however, we see the truth of our theory most plainly, and in dealing with this phase of the subject we include only adult joints. There is something in the resisting power of children that permits a cure of their joints by conservative treatment, often with a fair range of motion. Amputation at or just above a tuberculous joint (we speak always of one that has not been secondarily infected by pus germs) cures the disease, even if all the tuberculous tissue be not removed. It cures immediately by abolishing function, for abolishing function means a change in the character of the marrow and of the synovial membrane. An amputation at the hip cannot eradicate the diseased tissue from the pelvis, but it will cure tuberculosis of the hip, nevertheless. Amputations, however, are rarely resorted to except in desperate cases. Resection is the usual operation, and the best authorities hitherto have taught that one should go "wide of the disease" and eradicate every particle of infected tissue. This is an impossibility, and even those who teach this doctrine can not practice it. One could never be sure in re-

[1] Krause, König, etc.

[2] Quain's Anatomy.

secting a joint, that one had removed all tuberculous tissue, yet if bony ankylosis was secured, with primary union of the wound, *the joint was cured*.[1] In other words, the disease was cured by abolishing the joint. As soon as the joint was destroyed, the characteristic elements of it that offered a field for the disease, the red marrow and the synovial membrane, disappeared, and the disease died out.

If this statement is true, then a joint that can be destroyed can be easily cured by a resection, and one that cannot be destroyed cannot be easily cured. Let us see if the facts bear us out.

After a resection of the knee, if ankylosis be obtained, the portions of the epiphyses left behind gradually lose their cancellous structure, and the marrow in them changes from red to yellow. The femur and tibia become one bone, and in course of time a regular medullary canal is established through the entire shaft.[2] The knee is the joint that is most easily cured of tuberculosis by a resection. It is the one joint in the body in which firm bony ankylosis can be almost uniformly secured provided the tissues are capable of repair.

We have tried out this theory in three cases of knee-joint tuberculosis. The first, done a year ago, was a case of synovial disease that had lasted for five years under conservative treatment. A mere shaving was removed from the femur and tibia, and no dissection of the synovia was done. Firm bony ankylosis was obtained, and the patient was cured. The other two operations were done respectively three months and one month ago. Both were done in defiance of all rules hitherto laid down for operation in such cases, and in accordance with the theory elaborated in the laboratory. Our confidence in this theory is attested by the fact that the first was a private patient, a school teacher, who had had his joint lesion for about seven years. When seen first, five years ago, he had a typical synovial tuberculosis of the knee, and refused operation. Recently the disease had grown much worse, and the bones were evidently involved. At operation the synovial membrane was found badly affected and the cartilages eroded at their margins. We sawed off the tips of the condyles and chiseled off the cartilages of the tibia (under the inner we found a small pocket of pus), the inner surface of the patella, and a corresponding area from the trochlea of the femur. Only enough of the soft parts was sacrificed to give access to the bones. Not even the lateral nor the crucial ligaments were cut. The bones were then brought into place, and the wound was sewn up tight, except for a drain that was left in for twenty-four hours, and all the tuberculous synovial membrane was left behind. He has made an uneventful recovery; the wound is healed; bony union has taken place, though it is not yet firm; and the patient, free from pain, is walking on the leg encased in plaster-of-Paris. It was shortened by the operation hardly three-quarters of an inch. Examination of the tissues removed showed typical tuberculosis.

The other operation, done seven weeks ago, can not be quoted yet as final. In this case the saw revealed a bony focus in the external condyle, about one centimeter in diameter. We removed a bare centimeter from the condyles, about half as much from the tuberosities, and none of the soft parts whatever except a small clipping for diagnosis from the synovial fringe. We dissected out the patella also, and sewed the wound up tight without drainage. His further progress has been uneventful.

The tarsus. If, in a case with a focus in one of the small bones, the bone be excised before invasion of the joint, that is, if every bit of infected red marrow can be removed before the synovia becomes infected, the disease can be quickly cured. If a joint of the tarsus once becomes infected, it is well known that almost invariably (if not invariably) only an amputation will suffice to cure. In other words, in the complicated series of joints found here no

[1] The fact that in a number of our own resections a cure had followed our destruction of the joint, although we had not removed all tuberculous tissue, had seemed natural enough, but on the old theory of operating was hard to explain.

[2] Ollier, Dict. encycl. des sciences médicales, Paris, 1870. Ankylose. Page 191. "Les os une fois sondés, il s'opére une raréfaction de leur tissu au niveau de l'articulation; les deux canaux médullaires s'abouchent et ne forment plus qu'un canal unique. Toutes les parties placées en dehors du mouvement par suite de l'ankylose s'atrophient. Les saillies situées autour de l'articulation et servant d'insertion à des muscles, diminuent et même disparaissent. Ces observations prises sur des piéces du Musée Dupuytren se rapportent aux ankyloses osseuses."
Pl. Mauclaire. Nouveau Traité de Chirurgie, Paris, 1909. Ankyloses. Page 235. "Tantôt c'est une fusion osseuses complète à la fois périphérique et centrale; aussi la cavité articulaire a disparu, et les os sondés sur toute leur étendue ne font plus qu'une masses unique. La substance spongieuse des épiphyses peut disparaitre; les vacuoles dont elle est parsemée s'agrandissent, et les canaux médullaires des deux extremités osseuses ankylosées peuvent se réunir de manière à ne présener qu'un canal osseux médullaire commun et continu d'après Lacroix."

operation has been devised that will cause complete ankylosis, and change the character of the marrow or cause the synovial membrane to disappear.

The hip. No operation has ever been devised that can eradicate the tuberculous tissue from a diseased hip. The diseased acetabulum can only be scraped; the pelvic bone offers no field for extensive excision; yet the results of resection in this joint are excellent. Why? The operation removes the head of the femur, dislocation takes place, *the joint is abolished*, and the upper end of the femur is slung by fibrous structures upon the dorsum illii (articulation par suspension, Ollier). Hence the uselessness of the extensive dissection of the synovial membrane, and the removal of the head, neck, and trochanters of the femur—Langenbeck's operation. Removal of the head alone is all that is necessary to secure dislocation. We have done this operation also, of simple removal of the head, and can quote two cases in which the head of the femur was badly diseased and showed tuberculosis under the microscope. Both patients were cured with good function.

The wrist. What has been said of the ankle is true of this joint.

The elbow. One of two results is secured in resection of the elbow. If bony ankylosis takes place, then what we have said of the knee applies here. If a flail joint be secured, the result is much the same as in the hip. There is really no joint left. The two bones are simply tied together by fibrous tissue. Whether any red marrow is left behind in these cured flail elbows we are unable to say.

Tuberculosis of the phalanges (*spina ventosa*). A photomicrograph of our only case of tuberculosis of the finger accompanies this essay. An amputation was deemed necessary to cure the disease.

In our case of disease of the metatarsophalangeal joint of the great toe, a resection cured the disease in about one year.

Parenthetically it may be said that we have seen so-called subperiosteal resections done on a number of cases of spina ventosa in children with thorough dissection of the infected sinuses. Primary union of the wound was thus secured, and the disease appeared to be cured, but as soon as the bone had been re-formed (with its red marrow) the process broke forth with renewed vigor.

Although none of our specimens is from the spine, we might add that no operation has ever been devised for promoting ankylosis in these joints, and the extremely bad prognosis in this disease in adults is well known.

What does all this mean? It means that in knee-joint resections, instead of removing two inches of bone, and exposing the patient to a long and exhausting operation, we simply open the joint and remove enough bone to secure ankylosis, paying no attention to the tuberculous tissue left behind, for we know that it will shrink and disappear when the joint has been destroyed.

It means that in hip resections the operation of sacrificing the head, neck, and trochanter of the femur, and attempting the impossible task of eradicating all tuberculous tissue, will fall into disuse, and that we shall adopt another operation that is quicker, safer, and much less mutilating.

It means that the widespread custom of curetting a tuberculous ankle or tarsus or any other joint will be relegated to the obscurity it so richly deserves. It means, in short, a revolution in our ideas of treating joint tuberculosis.

In children, conservative measures will often suffice for a cure in accordance with this theory, and in operations on adults our principle should be the guiding one.

To sum up, then:

1. Only two tissues in a joint, the synovia and the red marrow, are subject to tuberculous disease.

2. Their presence is dependent on function.

3. When the joint has been deprived of function, they disappear.

4. When they disappear, the disease dies out.

Therefore, to cure a tuberculous joint deprive it of function.

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ARTIFICIAL RESPIRATION

FORCED RESPIRATION, WITH COMMENTS ON THE CABINET METHODS OF SAUERBRUCH, MEYER, AND OTHERS; ALSO A NEW METHOD IN THORACIC SURGERY

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ARTIFICIAL respiration, prior to the year 1887, consisted principally of the methods suggested and presumably utilized by Marshall Hall in 1857, Sylvester in 1858, and also according to Professor E. A. Schäfer (1), by Dr. Howard in 1868.

Since then in 1890, "the prone pressure," or as it might be termed, the Schäfer method, coming in the same category, might be added to the list.

Undoubtedly it was owing to the experiments and failures of the surgeons of the Dr. Hall period, about 1857, previously of LeRoy of France, Monroe, Dalyrumple, and others of England, that Mr. John Erichson in 1845, concluded that (2) "In spite of all the improvements and modifications of the technique, and the methods of inflation by bellows, the instrument never again came into favor, and was speedily forgotten, when the postural methods came into use."

Marshall Hall was especially severe, and justly so at that time. He considered it unwise and dangerous to attempt the forcing of air into the lungs by any mechanical means in efforts to save human life, and from 1857 to 1887, the medical world agreed with him.

On July 23, 1887, there came a positive demonstration against his decree; a human life, which could not be saved by the then known postural methods, was saved by forcible respiration by means of the bellows, which the medical profession had rejected for 30 years as impractical. This case was reported in the Buffalo Medical and Surgical Journal, November, 1887 (3). Within about three months following, Professor Dr. Boehm of the Allgemeines Krankenhaus, Vienna, Austria, saved the life of a patient, by the same method (4, 5, 6).

Other cases quickly followed (5, 6), and were of such a nature as to indicate that a new epoch in artificial respiration had been established in practice.

The third epoch is already here in the cabinet *negative pressure method* of Professor E. F. Sauerbruch, of the University of Marburg, Germany, who has given demonstrations of great value in its application to surgery of the thoracic cavity (1).

Suggested Classifications

THE FIRST DIVISION OF ARTIFICIAL RESPIRATION

This consists of postural methods, and movements of the limbs of the body, with intermittant pressure applied at different parts, or those originated by Marshall Hall, Sylvester, Schäfer, and others.

THE SECOND DIVISION

Forcible measures of instrumental control, the forced respiration, and now by some termed the positive pressure method, was first practically, systematically, and continuously for some years, utilized in saving human life by the author.

THE THIRD DIVISION

The diminished atmospheric pressure system with the cabinet or small moderately tight room, the so-called "negative pressure" system of Professor Sauerbruch.[1]

DETAIL OF METHOD OF FIRST DIVISION

In a few words I will attempt to indicate these methods.

That of Marshall Hall is produced by pressing upon the back and shoulders, with the body in the prone, face down position, producing the expiration; the body is then rolled to the lateral position by traction upon the arm and shoulder, to produce the inspiration. Repeat at respiratory intervals.

The Sylvester method is produced by drawing the arms of the patient when on his back upward over the head with a steady pull, to produce inspiration, by then lowering them to the sides of the thorax and adding a firm constrictive pressure, the expiration is produced. Repeat.

The Howard method. With the patient on his back, pressure is made over the lower part of the chest, retained a few moments, producing expiration; then relaxed, permitting inspiration. This is repeated to supply the requisite number of respirations per minute.

The Schäfer method, or as he terms it, "the prone pressure" method, is described by him as follows: (1) "The operator kneels or squats by the side of or across the patient, places his hands over the lowest ribs, and swings his body forward and backward, so as to allow his weight, alternately to fall vertically on the wrists and be removed; in this way hardly any muscular exertion is required." It is "completely efficacious and capable of effecting an air exchange greater than that produced in normal respiration," and also, "in cases of drowning there can be no question that the method is always indicated."

Its advantages are: "First, that it is fully efficient. Second, that it can be performed without fatigue by a single individual. Third, that it is simple and easily learned. Fourth, that it allows the tongue to fall forward and the mucus and water to escape from the mouth, so that the tendency of these to block the passage of air is altogether obviated."

An evident advantage in favor of the patient in a serious case over the Marshall Hall method, is that it conserves his energy by lessening the movements of the body, no lateral position being required. However, forced respiration has advantages over all postural methods in this respect. The postural methods are the great emergency methods when no instrument is at hand, but as we will see there is a field and a wide one for all the methods of artificial respiration.

There are other methods, but the above are the most utilized and are classed with the *first division* of the subject.

DETAIL OF SECOND DIVISION

This consists of the use of apparatus, by which atmospheric air alone, or combined with oxygen gas or an anæsthetic, is forcibly driven into the lungs, under proper regulation, through a tracheotomy tube, an intubation tube by means of a face cup or mask, which is made to tightly fit the contour of the face, inclosing the nose and mouth, to prevent the escape of air, or by the positive pressure cabinet, which in reality is a face mask on a large scale and in which the air must be rhythmically presented forcibly, and released, as in the principle of forced respiration.

This is accomplished by suitable bellows, single or compound, compressed air from a

[1] The positive pressure cabinet addition of Professor Willy Meyer, to the negative of Sauerbruch, does not alter our divisional system, even if mingled with the other (19).

cylinder or pump, an electric or hand blower, or other methods by which a steady column of air, of sufficient volume may be furnished under suitable pressure and control. (I do not specify the double cylinder pumps and other devices prepared for insufflation and *aspiration*, as in practice they have not proved safe or practical.)

In this division therefore the air is rhythmically presented so as to simulate natural respirations. It has been used successfully by the author on human beings of ages from eighteen days to adult life, and from a few hours to three or four days and nights.

It was through the incentive given to artificial respiration by the introduction of forced respiration (second division), by the methods of the author in 1887, when we first knew absolutely that we could respire for hours and days for human beings, with a perfection no more than equaled by physiological respiration, that the surgery of the thorax, through its utilization, became a practical possibility. Dr. F. W. Parham of New Orleans, La., was the first one to successfully remove a sarcomatous growth from the walls of the thorax, using forced respiration by the so-called "Fell-O'Dwyer" method for that purpose. The forced respiration prevented the collapse of the lungs and pneumothorax, the operation was completed, the chest walls closed with inflated lungs, and complete recovery of the patient ensued (18).

DETAIL OF THIRD DIVISION

This will call for a short preliminary statement to clearly appreciate its mechanism. Respiration is made possible in the thorax of the *vertebrata* by a partial vacuum existing in the pleural space, after the contraction of the lungs in expiration. This is represented by a varying negative pressure of 4 to 10 mm. of mercury. The surgical opening of the thoracic cavity without forced respiration to keep the lungs in an expanded condition, or the negative pressure method of the Sauerbruch cabinet, which accomplishes the same results through the retention of auto-respiration, is therefore a serious and dangerous procedure, as the external atmospheric pressure otherwise usually causes instant collapse of the lungs, producing dyspnœa, displacement of the thoracic viscera, shock, and death.

Professor Sauerbruch conceived the idea of having the body of the patient within a chamber, the air within rarefied to approximate the negative pressure in the pleura of 4 to 8 mm. Hg., while the head of the patient was outside of the chamber, permitting the respiring of normal pressure atmosphere. Under such conditions, by varying the negative pressure as needed, the thorax could be opened within the rarefied chamber, without the collapse of the lungs, and surgical work conducted with almost the same degree of confidence as operations on the abdomen. When we consider the wide range of pressure, from the compressed atmosphere of the engineer's foundation caisson, to the rarefied air of the mountain top, which the human body readily withstands, it is seen that the comparatively light rarefaction of the air of the negative chamber will not interfere with the work of the surgeons within the cabinet.

I believe it may be assumed that the negative pressure method could be carried out in a moderately sized, approximately air tight room built within a hospital or without, provided with apparatus of sufficient exhaust volume to insure an interchange of incoming filtered air to provide a pure supply for the use of the operators and the patient, and yet control properly the negative pressure. The necessary requisite is that the exhaust blowers be of sufficient capacity to quickly lower the pressure in the room. By valves suitably located and controlled for the ingress of the atmospheric air the pressure can be modified and controlled to a great nicety. Reference must be made to the admirable paper of Professor Sauerbruch (1) in the September 5, 1908, number of the Journal of the American Medical Association, to appreciate what a great advance in artificial respiration his negative cabinet work has given us.

At this point we must bring in the fact that not only have we negative cabinet, but also positive cabinet methods, and they are multiplying so rapidly that it will not be long before the exact value of all of these different methods will be practically known.

As to the positive pressure cabinet of Pro-

fessor Willy Meyer (19) within the negative cabinet, to be available for positive respiratory work, the air must alternately be raised to the degree for inspiration, and released for the expiration if it is actual positive or not passive respiration. If we have the positive at + 3 mm. Hg. and the negative at −3 mm. Hg., we have a differential of 6 mm. Hg., which is necessary to the conditions of auto-respiration, although both positive and negative factors enter into the production of the respirations. If we produce respiration by the positive cabinet alone the pressure must be raised to about plus 6 and quickly released to zero the same as positive respiration with the face mask or intubation tube. The question as to whether the small cabinet of Brauer (7), or the larger experimental one of Doctors Janeway and Green (8), or the yet larger one of Dr. Meyer (19) is better for positive pressure work than the face or air mask when properly utilized (9) is an interesting one. The principle involved is, it seems to me, essentially the same, except that the air is more equably presented in the cabinets than with the face or air mask, although the positive pressure would necessarily be the same in all.

As this paper partakes somewhat of a historical nature it may be proper to cite some features of a discussion which occurred eighteen years ago, when we were all groping in the dark in our consideration of this subject (10). Dr. John O'Dwyer, whose memory we revere, expressed the opinion that "In forcing air through the mouth or nose of an insensible patient, the tongue, unless secured, is almost certain to cause obstruction, or the vocal chords may be forced together by the inrushing air, and act as a valve, as in paralysis of the abductor muscles, because there is no expansion of the glottis as in normal respiration. This theoretical objection was contrary generally to my experience at that time, as shown by the published histories of cases.

In case 11 the face mask was used for four hours, in case 15 for seven hours, in case 17 for two hours, case 19 two hours, case 21 seven hours, case 22 four hours, case 24 five hours, case 25 two hours, and in all of these cases for the time mentioned, there was absolutely no interference with the air passing directly to the lungs. It has been disproven in many cases since then.

CLAIMS OF DIFFERENT METHODS

Some one has said, "It is comparatively of little consequence whose mind conceived the thought. Inventors often think of the same thing. No invention or discovery is of much value, however creditable to the mind that originates it, until it is developed and put into such shape as to become practically available, so that the conception may be seized upon by other minds, and wrought into a tangible reality."

Marshall Hall, Sylvester, and Howard put their discoveries into such shape that the world has utilized them, saving thousands of human lives. Professor Schäfer has given us apparently the best method of the first division.

The author must refer to his published papers for a record of his results, which are outlined in the partial bibliography of the subject appended to this paper.

Professor Sauerbruch has also apparently demonstrated the value of his discovery, that as with the others, his method can be generally utilized and advanced to its worthy niche in the temple of medical progress.

COMPARISON OF EFFICACY BETWEEN THE FIRST AND SECOND DIVISIONS OF ARTIFICIAL RESPIRATION

In the author's first case (3) Mr. P. B. had taken grs. xx of morphine, and some chloral hydrate, which was all absorbed. The Sylvester method and every known means to resuscitate were unsuccessfully applied, forced respiration was applied under great disadvantages, and the life of the patient saved. The period of forced respiration was 2½ hours.

The second case of author, which occurred December 10, 1887, was really made a test case between the Sylvester method and that of the author. Mr. J. A. V. had taken two ounces tr. opii.

Artificial respiration by the Sylvester method was faithfully kept up until it was clearly demonstrated that the life of the patient could not be saved, after which the author's apparatus devised for use on man was utilized for twenty hours, saving the patient's life.

In comparing these two divisions there are other important factors which have a bearing upon the subject. Dr. Carlton R. Jewett, of Buffalo, N. Y., after witnessing the case of J. B., January 24, 1888, stated (6) "The simple institution of artificial respiration (first division) through the bodily movements required, might have proved disastrous to the patient, owing to his weak condition from loss of blood." In a paper read before the New York State Medical Association in 1888 (6) I said, "The contrast between the two is very noticeable. In artificial respiration the patient is tugged, squeezed, and rolled about, according to the method employed; while in forced respiration, often when *conscious* he is entirely *passive*, and will lie for hours without appearing uncomfortable, as long as the latter is properly kept up." This passivity or inhibition of the active auto-respiratory factors, diaphragmatic and thoracic, has from the first been noted in my work with tracheotomy, the face mask as well as with the intubation connection.

Imagine the keeping up of any of the postural methods, even the Schäfer, from Tuesday morning, 2 o'clock, until Friday morning at 8 o'clock (17), nearly eighty hours, before the life of the patient was saved (17). Another case may be cited, H. J. W. (16). In this case the forced respiration was begun, upon a Tuesday over 16 years ago, at 9 A. M., kept up until Wednesday 11 A. M., again utilized 2 P. M. Wednesday until Thursday, 9 A. M., and finally used, beginning Thursday, 7:20 P. M., and again kept up continuously until Friday night at 10 o'clock, the patient making a good recovery.

COMPARISON OF EFFICACY BETWEEN THE POSITIVE AND NEGATIVE METHODS

In history it is rather early to attempt a comparison between these divisions, although much of interest may be stated. We must not lose sight of the fact that outside of thoracic surgery, there is a wide field of cases more suitable to forced respiration than to the postural methods, and some in which it is questionable whether the negative system could be applied. In cases where the respiratory center is paralyzed by poison or shock, we may question whether the negative method would be applicable.

Herein lies one of the great and important advantages of the forced respiration over the negative or the *auto-negative*. This is a tentative proposition, as I am not experienced yet in actual negative work. Take a patient *in extremis*, a condition we may often find in thoracic surgery.

Negative cabinet respiration means auto-respiration, and calls upon the already overtaxed and weakened nerve centers to formulate the important respiratory impulses, in other words negative respiration decreases this energy while forced respiration conserves it, and may mean in many cases the difference between success and failure, as a life saver.

COMBINATION OF NEGATIVE AND POSITIVE METHODS

Both Drs. Janeway and Green (8) and Dr. Willy Meyer mention the possibility of artificial respiration being kept up by their respective positive cabinet methods, the mechanism permitting the air supply to be suddenly increased to produce the inspiration (19) and suddenly lowered to atmospheric pressure to allow expiration to take place. Whether they have obtained as complete control of the respirations as I have with my apparatus I am not prepared to state.

It can safely be assumed that with my apparatus similar to this, the utilization of the positive with the negative cabinet is feasible and practical, and so far as its work is concerned it is not an experiment.

THE LABORATORY AND OTHER APPARATUS OF THE AUTHOR

I have been fortunate to secure the original *laboratory* bellows (Fig. 10), which, when I was an assistant to Professor W. H. Mason, was used in the Physiological Laboratory of the University of Buffalo, N. Y., years 1880–1882. It was never thought to be a life saver.

The apparatus with which the first life was systematically saved by forced respiration in 1887 (Fig. 11), is the property of the Buffalo Historical Society, and has been kindly loaned

Fig. 1. Double bellows or air supply device.
Fig. 2. Air valve, with oxygen and anæsthetic tubes.
Fig. 3. Air cup or face mask, intubation tube, etc.
Fig. 4. Oxygen supply apparatus.
Fig. 5. Anæsthetic container.
Fig. 6. Anæsthetic control valve.
Fig. 7. Rubber manometer.
Fig. 8–8. Three-way connections.
Fig. 9. "Maelzel" metronome.

to me for exhibition at this meeting. It was devised for use in laboratory vivisection work, and was provided with a two-way valve (Fig. 12) and cannula combined, connected by a rubber tube with a bellows. The stop-cock of the valve turned one way, allowed the air to pass into the lungs from the bellows; by turning it a quarter turn the air expired was made to pass out through a fenestrum in the side of the valve. This opening was so small that only a portion of the expired air could pass through it, so that a large percentage had to escape by the side of the cannula.

This was a fortunate matter in this first attempt to save a human life by this method of forced respiration, as it allowed the expiration to become complete, and make the respiratory work effective. The difficulties arising from the incompleteness of this apparatus were such as to cause to be devised a valve on the cornet-piston order, to be used for life saving purposes (Fig. 2). This valve offered absolutely no interference with the auto-expiration, but rather assists it, as was afterward learned. In a paper on forced respiration of November, 1887 (3), these words were used, "A valve so arranged that the surgeon can completely control the passage of the air from the bellows to the lungs, and when free will permit the air to pass readily out of and into the lungs, or in other words, so that the surgeon need only manipulate the valve during the inspiration," or insufflation.

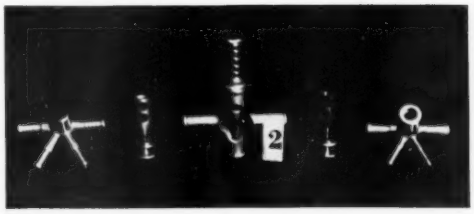

Fig. 8 A. Air valve of author (1887).

In the twenty-two years since these words were written, there appears no good reason to change their import. However, it was necessary to provide another outlet in the valve before it would be completed even for simple respiratory purposes (without gas, oxygen, or an anæsthetic), and to arrange it so that the double bellows or other means which produced

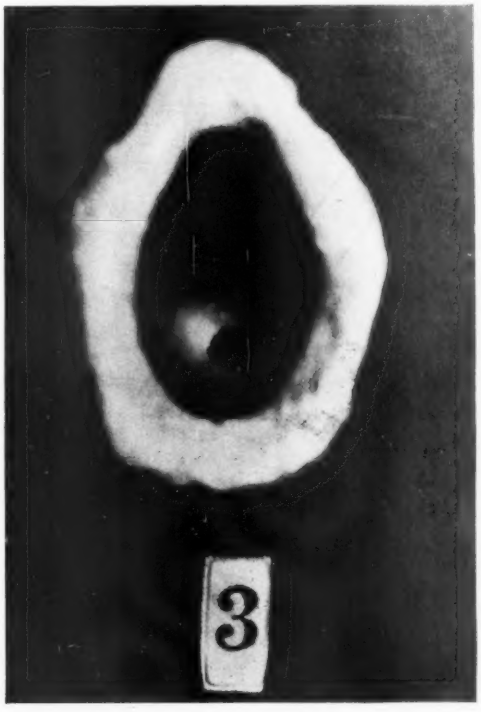

Fig. 3 A. Air cup or face mask of author, edges faced with hard wax.

Fig. 10. Vivisection bellows, University of Buffalo, 1880.

a steady column of air, could work *continuously* for two important reasons:

First: To utilize the movements of the bellows as an ever present and constant guide for the time of both inspiration and expiration, and as long experience has shown, providing a better and safer factor in the prevention of overdistension, than a mercurial manometer, as a convenience in the working of the bellows, and to make the work practically simple (6).

RHYTHM OF THE RESPIRATIONS

In considering the question of the rhythm of the respirations and necessarily of the *safety* of the entire procedure, it was found natural and much easier to work the bellows about ninety to one hundred and eight times per minute than sixteen to eighteen times.

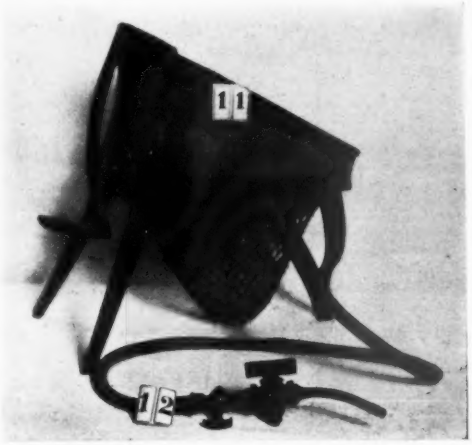

Fig. 11. Vivisection apparatus of author, with which his first life (human) was saved, 1887.
Fig. 12. Brass control valve of No. 11.

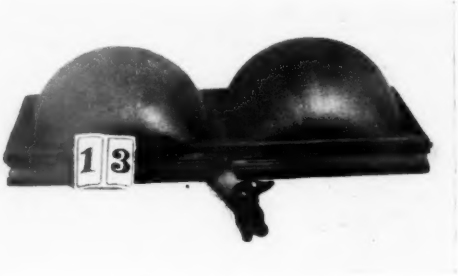

Fig. 13. Author's rubber lungs for demonstration. New York State Medical Association, 1888.

The attempt to have the bellows large enough to simply provide one movement to a complete inspiration, makes them cumbersome, uncertain in action and dangerous when compared with the plan adopted from the first work that brought satisfactory results in this field.

Second: The air was under constant pressure in the air valve, with steady working of the bellows. The instant the piston was pressed down full stroke the air was free to enter the lungs and steadily insufflate them during the period of three movements of the bellows in the adult; the piston being released for the same time gave the period for expiration. This provided sixteen to eighteen respirations per minute, supplying the needed quantity of tidal air. By this system the respirations may be varied at will, and utilized with any constant method of supplying the air. In successfully breathing for an infant eighteen days of age, one movement for inspiration and one for expiration provided thirty-two respirations per minute.

With an air-tank or constant blower gauged in quantity and pressure, a "Maelzel metronome" (Fig 9), as used by musicians, may be used. When set at eighty-four or ninety-six strokes per minute, and the one-two-three counts made to correspond to it, the safety of the work is assured.

Instead of using a mercurial manometer as a safety factor, and which by the way, is very unsatisfactory on account of the small range and irregularity of movement of the mercury, a rubber manometer (Figs. 7, 13, and 14) on the plan of the artificial lungs described in 1888, is recommended (6).

Fig. 14. Single lung arrangement, which may be used in preference to the mercurial manometer.

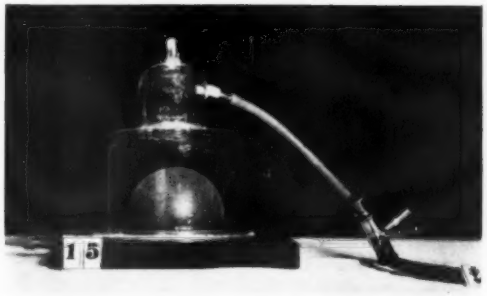

Fig. 15 A. Arrangement to illustrate *forced negative respiration.*

GREAT ADVANTAGE OF THE AIR VALVE

This valve (Fig. 2) gives a better control of the respiratory movements of the lungs for operative work in the cavity of the thorax, than any other method with which I have become acquainted. It is true, that in the negative auto-respiration of Sauerbruch we have the incursions of the lungs taking place in the natural manner, i. e , they expand and contract as in the natural pleural space, but not so as to accommodate the surgeon in his labors. They are continually in his way, but of course may be "mopped" out of his operative field by the pledgets of gauze. However, this interferes with respiration, which is a serious matter.

With the valve method as we will show we can control them as follows. The respirations may range from five to fifty per minute; at will they may be made as long or as short as we choose; adapt them to the degree of cyanosis of the patient; follow the auto-respirations, by immediately changing from a partial insufflation to follow an auto-expiration, or *vice versa;* increase the insufflations and decrease the expirations, all of which have been found expedient in closed chest cases on living human beings.

In surgical cases of the thorax, we may collapse the lungs almost completely; use short, quick respirations to keep them out of the field of the surgeon in a manner that cannot be as satisfactorily effected by the auto-respirations in the use of the Sauerbruch cabinet, and when the surgeon is ready to close the thorax, at the termination of the operation, keep the lungs completely inflated or to any extent for any length of time, until the final closure stitches have been taken, and the thoracic cavity placed in physiological respiratory order again. To be certain that this has taken place, we may keep up the forced respiratory work with the closed chest, until the influence of the anæsthetic has well passed away, before removing our intubation or tracheotomy tube from the neck of the patient.

THE VALVE EXHAUST IN EXPIRATION

A valuable feature of this valve (Fig. 2), which has never before been mentioned, and

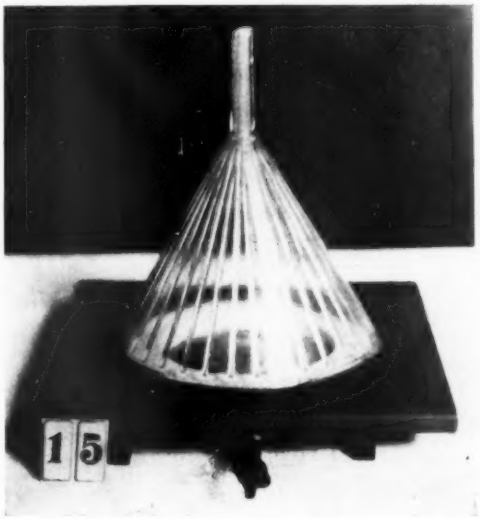

Fig. 15 B. Arrangement to demonstrate *forced negative respiration.*

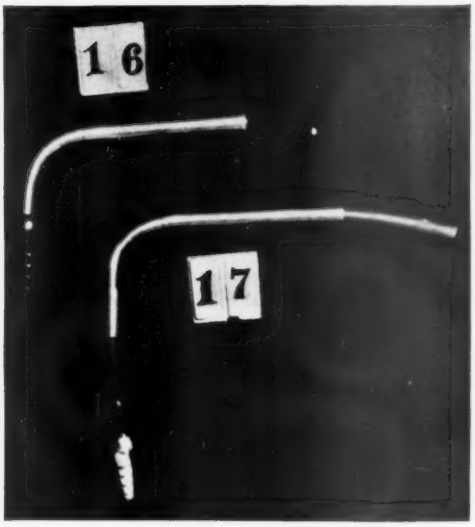

Fig. 16. Intubation tube of Dr. O'Dwyer, 1884.
Fig. 17. Intubation tube of author, 1908.

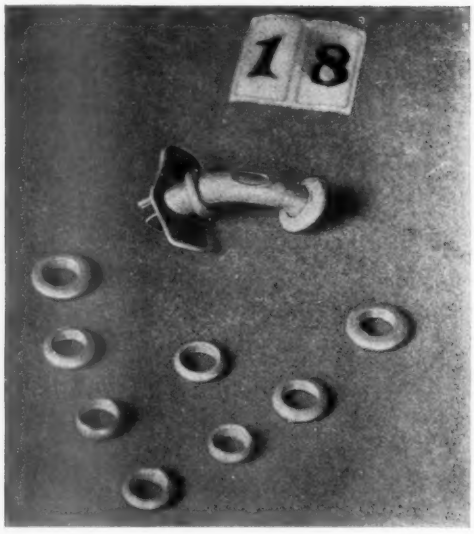

Fig. 18 Tracheotomy tube and rings of author, 1887.

which experience has proven to be of marked value in aiding interchange of gases, is the very slight exhaust, equivalent to about one-third mm. of mercury which always takes place if desired, during the expiration. It aids the auto-expiration, but is so slight as not to interfere with the auto-inspiration or expiration at any time. This may seem paradoxical but in practical reality is as stated.

UTILIZATION OF OXYGEN GAS

This is a necessary factor in forced respiration, the Williams (16) and Archer (17) cases demonstrating the absolute need of it in extreme cases. It is through the air valve that it is supplied to the patient. The quantity is controlled by the stop-cock of oxygen cylinder (Fig. 4), the gas passing through a wash bottle into the air valve only during the insufflation. The practical administering of it with the air valve presents no difficulties whatever.

UTILIZATION OF ANÆSTHETIC WITH AIR VALVE

The latest addition to the valve is the anæsthetic tube and the method by which the anæsthetic is gauged and passed into the lungs with the insufflation. This tube receives the anæsthetic vapor, either chloroform or ether, from a three-necked "Woolf" bottle (Fig. 5), which may be partially filled with absorbent cotton, in the following manner. It is borne in mind that the air from the tank or bellows is constantly passing out of the air valve under pressure. About ten inches from the air valve, and between it and the bellows a three-way connection (Fig. 8) is placed, uniting the bellows, air valve, and the "anæsthetic container" by means of rubber tubing. The anæsthetic (and cotton) is placed in the bottle, the air from bellows passes through glass or metal tubing into or over it according to the anæsthetic used, through one neck of the bottle and has an exit through the middle neck which connects with the anæsthetic tube of the air valve. The third neck is utilized for filling and emptying the bottle and is supplied with a common cork stopper. At all times both during the inspiration and expiration the anæsthetic is being vaporized by the air continually passing into it. When, however, the piston of the valve is pressed down to its full extent, the inrushing air carries with it into the lungs the vaporized anæsthetic in sufficient quantity to anæsthetize the patient.

A control valve (Fig. 6) is placed in the tube

between the "Woolf" bottle and the air supply to regulate the quantity of the anæsthetic or cut it off altogether.

The anæsthetic may be used with intubation, tracheotomy, or face mask, and with the latter is applicable for general anæsthesia. I believe I have arranged a method of utilizing anæsthetics in connection with forced respiration that is both practical and easily applied.

INTUBATION TUBE, TRACHEOTOMY TUBE, FACE OR AIR CUP

The intubation tube, tracheotomy tube, and what I will now term the air cup, instead of mask, are all of positive value in forced respiration. The apparatus is so arranged that it can be readily attached to one or the other.

In emergency cases the air mask or cup has been of great value in sustaining patients until tracheotomy could be performed or intubation made. It may be made of tin or hard rubber with the edges which are applied to the face or body of wax [1] (9), which, by heating, will make it conform to the surface of the body (Fig. 3). This application should be exact and the fitting may be done during the progress of a case.

The tracheotomy tube which gives us the most complete control of the respiratory function compared to the intubation tube or air cup is an ordinary double tube with a fenestrum in the outer tube, to permit the patient to talk when inner tube is removed. To the tracheal end of the tube rings of different sizes are adapted to prevent escape of the air and thus more thoroughly control the respiratory work. In long continued cases tracheotomy is still advocated, but not until the air cup and intubation tube have been utilized. One difficulty is that it is impossible to determine the length of time a case may take.

The intubation tube may be the O'Dwyer (Fig. 16) form of brass tubing, bent on a radius of four centimeters, with an O'Dwyer conical tip screwed to the tracheal end.

I have devised an intubation tube (Fig. 17) which consists of a rubber tube loosely fitting into brass tubing bent as above. At the tracheal end of the rubber tube a conical tip of a size to loosely fit the trachea is securely fastened, so that when the tip has been passed into the larynx by aid of the curved brass tube, the rubber tube may be advanced with its tip into the trachea a greater or less distance. With the tip in the trachea, there may be less irritation than in the larynx as with the O'Dwyer tube, and the small rubber and brass tube in the larynx is less apt to injure the vocal chords and cause irritation.

[1] The use of dental wax for this purpose was first suggested by the ate Amos C. McAlpin, D. D. S., of Warren, Pa.

FORCED NEGATIVE RESPIRATION

As stated previously, the Sauerbruch negative cabinet method, from its design, produces auto-respiration. Modifications of the auto-respiratory range of the lungs may be produced by increasing or decreasing the negative pressure. When for instance it is desired to close the pleural cavity, the negative pressure is increased sufficiently to produce such an expansion of the lung as may be needed before final closure of the wound takes place.

We are depending principally on the auto-respirations in all this work. In a condition of the patient bordering on "*extremis*" auto-respiration may be greatly impaired or entirely inhibited. In paralysis, for instance, of the respiratory centers, auto-respiration cannot ensue, and in such a case a negative cabinet would be useless, unless that within the rhythm of normal respiration, the pressure could be suddenly changed from the highest negative pressure, 7 to 10 mm. Hg., needed, producing inspiration, to atmospheric pressure, producing expiration, and kept up rhythmically.

This does not seem to be practical in a large negative cabinet and, so far as my reading goes, has not been discussed, so that it is not necessary to enlarge upon it. However, from this line of reasoning and with this little improvised negative cabinet we have added, I hope, another to the valuable features of our present respiratory progress.

With this experimental cabinet (Fig. 15) and artificial lungs, simulating the thorax with an open wound and collapsed lung, the electric blower was started. The intake of the blower was attached by a rubber tube to the outlet of the now negative cabinet, and at once the lungs previously collapsed, were inflated. By dis-

connecting the rubber tubing producing atmospheric pressure, the lungs immediately collapsed.

The air valve (Fig. 2) was at once applied but in a reversed position to its use for positive respiration, so that the air passed from the negative cabinet, or opening in the thoracic wall, which for illustration, we may wish to term it, to the intake of the blower through the valve.

The moment the piston of valve was pressed down, the collapsed lung filled up; releasing the piston produced the expiration, and with the one-two-three time rhythm, there was being produced a regular, uniform, *forced negative respiration* as perfect in all its features as forced or positive respiration could possibly be.

We have here the conditions simulating the injury. The wound in the thorax is represented by the opening in the spout of the glass funnel. In an actual case we would simply use our air cup, preferably of glass, to make the air tight connection with the thoracic cavity, and proceed with our *forcible negative respirations* (Fig. 15).

This is necessarily an emergency appliance which would frequently be useful in punctured wounds of the chest walls, with collapsed lungs and a pneumothorax, and frequently until the positive pressure or negative cabinet could be brought into use. What makes it more problematically useful is that the simple reversing of the positive pressure apparatus that is shown you to-night provides the forced negative pressure appliance.

NOTE.— Dr. Fell gave demonstrations illustrating all the points of his paper. His rubber lungs, double bellows, and blower, run for both positive and negative pressure by electric motor, were utilized.

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FRACTURES OF PATHOLOGICAL BONES (OSTEOPSATHYROSIS) AND THEIR TREATMENT[1]

By CARL BECK, M. D., Chicago, Illinois

WITH the addition of the X-ray as an aid the diagnosis and treatment of fractures of normal bones have reached the state of perfection of an exact science. There is, however, a large field in the pathology of bone injuries and their repair which still requires a great deal of study; viz., the group of abnormal bone structures.

The bone develops upon the base of cartilage or fibrous tissue in such a manner that from certain points of ossification lime salts are deposited in and between the cells. These lime salts are massed more closely on the outer contours than on the inside of bones, and are arranged according to laws of mechanics and architecture, so as to render the bone a very firm and at the same time a light structure.

There is a constant change consisting of the absorption of lime salts and new deposits from infancy to old age. The carriers of these changes are large cells, myeloplaxes, or osteoclasts.

According to the researches of Metchnikoff and his assistant, Weinberg, the cells develop an acid and carry off the lime substances dissolved in the same, and either excrete them or deposit them in other tissues. This seems to be clear through the changes produced in the bones of old people. The bony structures lose much of their hardness (senile atrophy). During this period of life lime salts are found in cartilages of the joints and spinal column, also in the walls of the blood-vessels (arteriosclerosis).

Under normal conditions this loss of substance is brought about through the so-called lacunar arrosion, the osteoclasts forming lacunæ (Howship) in the bony trabeculæ.

Under pathologic conditions, for different reasons, the absorption is produced irregularly; either the lime salts are withdrawn all along the borders of the trabeculæ, forming what is called the osteomalacic hem (osteomalacia), or replacing the bony structure by other tissue or by softening and liquefaction (Schmaus).

There are conditions of pathologic nature in which the relative amount of one or the other element prevails. We find, for instance, bones in which the lime salts are extraordinarily developed, such bones being unusually hard and ivory-like (osteosclerosis).

On the other hand, we find the other extreme, in which the lime salts are missing to a certain extent, making the bones very soft. There are many varieties of this absence of lime salts with combinations of different changes in the remaining structures, from which a number of distinctly typical diseases originate. There is, for instance, the disease of rickets, a disease of infancy caused by lack of lime salts, particularly in the neighborhood of the joints, and hypertrophy of osteoclasts and vessels. There is the osteomalacia with lack of lime salts with enormous numbers of osteoclasts.

The lack of lime salts may be due to infection, such as tuberculosis and paralysis of the nerves.

In other instances the lime salts disappear with the formation of cavities which are either lined with epithelium or not, and filled with a hæmorrhagic fluid, the so-called bone cysts.

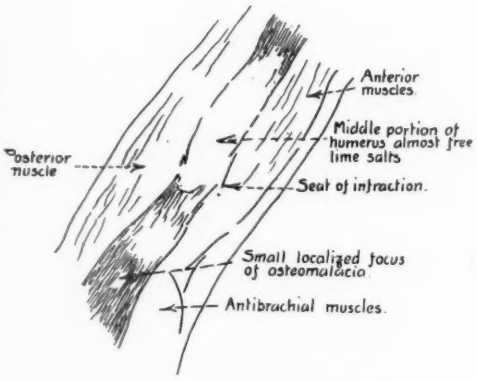
There is still another form of cavity formation in bone through the softening of tumors with absorption of lime salts.

All of these varieties and their subdivisions form more or less typical diseases. While the bone of a healthy individual can withstand a certain force without breaking, these abnormally constructed bones are easily broken. This quality has been called by the barbaric name of osteopsathyrosis (ὄστεον ψάθυρος) which means fragility. This is not a disease but is a symptom.

The fragility of bones depends upon many factors. It is well known that the same forces

[1] Read before the Chicago Medical Society.

Fig. 1. Left humerus, the middle portion before treatment.



which produce a break of bone in one individual will, oftentimes, not have the same effect in another; that age, sex, health and disease play an important role in the etiology of fractures.

A child escapes an injury of a bone because of the elasticity of the bone structures, while an old decrepit individual sustains a fracture.

Still more important is the pathologic condition of bones in this respect. The literature of recent years and of older observations has a number of instances to relate of so-called pathologic fractures, in which a slight trauma, often a turn in bed, caused the breaking of a long bone, and in such cases the examination proved an abnormal state of the bony structures as, for instance, a sarcoma or carcinoma of bone, or of other rarefying conditions.

No method of examination has helped us more in this respect than the study of the bony structures with the X-rays, which, at a glance, show us the condition of same.

We have passed the stage of being obliged to depend upon theories. We can now demonstrate these changes ad oculos. When we pass before our eyes a large number of skiagraphs of the same region of the body, obtained from different individuals, and examine them as to the density, we immediately notice a great variety. The cancellous trabecular structure, as well as the eburneous, differ greatly in different individuals and this certainly has some bearing on the fragility.

We have observed, for instance, that the bones of tuberculous and syphilitic individuals are different from those of healthy individuals, and even the same individual shows a difference in a time of sickness and health.

These differences and changes become more interesting when we come across some of the bone diseases in which these apparent inequalities of salt deposits are so pronounced as to form the most characteristic feature of the skiagram. I mean the condition of cystic degeneration of the bones.

I am positive that a number of so-called bone cysts in long bones are simply due to lacunar absorption and have erroneously been called bone cysts. Nevertheless, there are also real bone cysts. When first glancing at the skiagram the bones appear different in that the lines of shadow and light are distorted, irregular, and that the shadows of bones are more or less effaced. It is natural that such

bones must have lost a great deal of their resistance and that they are more fragile on that account. In such instances the bones may break at a slight provocation, by a simple fall. It may even be that the fall is the result of the break of the bone in such a way that suddenly the weight of the body kinks the softened and rarefied bone, causing the individual to lose balance and fall. That which is considered the cause of the fracture is, in reality, the effect of it, namely, the fall.

In some instances these changes concern only a limited portion of the skeleton, while in others they are universal throughout the bony system.

During a period of years we have observed a number of cases of this kind, but only in the last few years have we found the cause for some of them, and this knowledge was obtained principally through thorough examination of the bones by the X-rays.

Without wishing to write exhaustively on the subject of repair of these abnormal bone conditions I will endeavor to describe a few of them which we had an opportunity to study carefully, particularly as to some new ways of treatment.

Fig. 2. Left elbow.

OSTEOMALACIA

Osteomalacia is a disease well known in some countries and studied exhaustively but not yet fully understood. The essential osteomalacia is a well characterized disease, beginning with pains in different bones but particularly in the pelvis, and a gradual softening of the bones of the skeleton, so that the bones infract and bend, ultimately causing the body to become a distorted unwieldy mass of flesh and softened bones. It is principally a disease of pregnancy, but is also found outside of pregnancy, in men and even in children (Latzko and Preindelsberger). Fischer of Prag reports a whole family afflicted with osteomalacia. It also occurs in animals (Bonley). It is first mentioned by Grehovius. Buisson could report three cases in 1831. Trousseau called it the rickets of the adult, but Rindfleisch established it as a clinical entity.

Pathologically the changes are principally in the bones. The eburneous portion of the bones becomes porous and looks as if it had been eaten away by an acid (Saulnay). The bone has a grayish color (Stransky) with a bloody or grayish fluid dripping from the pores. The trabeculæ of the marrow are either gone wholly, or are very much thinned and surrounded by a hem of transparent tissue, and soft, so that the bone can be cut like a cartilage with a knife. Howship's lacunæ and Haversian canals enlarge, and the marrow is congested. Aside from these changes microscopical examination reveals a large number of embryonal cells including a large amount of fat. Chemically 60 per cent of fat is found in the marrow against 24 per cent of normal (Marchand).

Many theories have been advanced as to the cause. First of all the chemical theory taught that a superabundance of lactic acid (Marchand) or phosphoric (Renard) is the cause. Rindfleisch thought that passive hyperæmia through the carbonic acid is the cause, while others declare it due to toxines. Particularly Zuern blamed a certain micrococcus,

Fig. 3. Right humerus near elbow joint; the whole lower third of bone osteomalacic.

Fig. 4. Right humerus, side view; lower third osteomalacic.

which he cultivated from the bone marrow, but other authors could not find it. An interesting and somewhat convincing theory was advanced by Petrone, an Italian author, who produced such conditions by intravenous inoculation of nitrous earths. He blamed a nitrous ferment as the cause.

The utero-ovarian theory, brought forth by Fehling, is based upon empiricism. Knowing that after removal of ovaries the condition sometimes disappears, the trophoneurotic influence of the ovaries was thought to be the cause, after Virchow, and before him Ogle in England (1871), had blamed the nerves for these changes. Unfortunately for this theory, the ovaries, after removal, were found to be normal.

To me the theory of Bossi seems the most probable that the suprarenal capsules have an influence upon the regulation of the salt deposits in bones, and that the absence of the particular secretion is responsible for the riot of the cells carrying on the absorption of lime salts. It seems to be borne out by experiments as well as by the good results obtained by Bossi and others, and also by myself, by the use of adrenalin.

Bossi, who lives in a country where osteomalacia is comparatively frequent, found that an injection of adrenalin removed not only the pain, but gradually cured some of his cases. He therefore undertook some experiments on sheep. He removed the suprarenal capsule and the result was as he expected it to be. It was followed by changes almost identical clinically and pathologically with osteomalacia, and thus established the connection between growth of bones and the suprarenal capsules. Other surgeons followed his suggestion and had the same experience.

In our country osteomalacia is very rare. I have seen only two case of this disease in my practice, both coming to my notice within a recent period.

While connected with Professor Schauta's clinic in Prague I had opportunity to see two cases of osteomalacia in pregnant women, both having an oöphorectomy for the purpose of cure. They both improved after the operation as far as we could judge in those days by clinical observation. All we could say was that the pain and tenderness of the bones disappeared and that the patients could again be about. In the present day we have much better means for determining the cause and effect. We can observe the changes directly with our eyes.

One of the cases which came under my observation only within the last few weeks is the case of a woman of 65 years, who had been well until a few months ago when she began to have a great deal of pain in her spine and was unable to walk. The pains were located in the neighborhood of the third and fourth lumbar vertebræ, irradiating towards the front. At the same time the woman seems to be growing smaller rapidly. The upper part of her body falls into the pelvis and she walks with great difficulty, falling, so to speak, from one side to the other. The spine in the region mentioned above is very tender. There are some symptoms of irritation of the bladder, due to some pressure upon the spine.

The X-ray picture of this case shows a certain change in that anatomical region which has been described by Neugebauer, and which is due to a softening of the tissues, particularly the cartilages, and a slipping of the same, called spondylolisthesis, but the underlying pathologic condition of this case is osteomalacia as is clearly shown by the radiograph. Under the hypodermic injection of adrenalin the case is improving.

More characteristic and important on account of its relation to fracture is the second case, which we have now observed for months and which I have the pleasure to demonstrate here to-night.

Miss S., now about twenty years of age, gives the following history. She was a robust infant until she began to cut teeth, when she had two spasms in one day. She had the usual children's diseases, such as mumps, measles, whooping cough, chicken pox, and when about twelve years old had some enlargement of the thyroid. This disappeared when she began to menstruate at the age of thirteen to a certain degree,

Fig. 5. Left humerus after treatment; new deposit of lime salts in bone clearly visible when compared with Fig. 1.

but not altogether. About one year previous to an accident to which she attributes all her trouble an oak locker fell upon her left hip which caused her to limp for some time, but she had recovered fully, when she had her fall upon her left hip and broke her left femur.

Mr. S., her brother, called on me one day in November, 1908, and told me a sad story about his young sister, a girl of nineteen years who had had a fall about a year previous, sustaining a fracture of the femur and had been bedridden ever since. The doctors who had charge of the case had done everything possible under the circumstances, but since the patient did not get well, concluded that the leg was the seat of tuberculosis, and would have to be operated upon or amputated to enable her to regain her health. He brought me two X-ray pictures which showed the condition of the femur, viz., a very angular fibrous union of the two fragments.

The patient was brought to the hospital and I noted the following status: A frail skeleton, rather undersized, left leg about four inches shorter, very painful and swollen, the knee stiff and swollen. An angular pseudoarthrosis or fibrous union of a fractured femur in the upper third, the usual position of the fragments, the upper one drawn outward and the lower one inward by the traction of the respective muscle groups. Above the popliteal region was a very painful indurated transverse scar from a slough produced by a plaster cast, which had cut in and caused a septic infection which

Fig. 6. Right hip joint, osteomalacic region in upper part of femur.

Fig. 7. Left femur, fractured and dislocated before treatment.

had almost carried off the patient. The foot was in a pes varus position, the large toe very painful from constant injuries during movements. The patient could move her leg only with great pain by the aid of her hands placed on hip-joint, which was free.

Our X-ray picture did not reveal to me, at first, the true nature of the bone lesion, and from the findings it was evident that nothing else but an operative procedure (an opening of the leg on the site of the fracture and an apposition of the fragments with splints, according to Lane's method) would be the best. I incised the femur over the seat of the fracture, and after adaptation of the freshened fragments I joined them by the application of two aluminum splints which were screwed on with six screws in perfect condition. An extension was superfluous. During the operation I had noticed the abnormal condition of the bony structure. The eburneous portion of the bone was very thin, the cancellous tissue very soft, so that the screws would not hold well in the soft structure. Nevertheless, the result seemed gratifying, according to a picture taken several weeks subsequently. The splints seemed to be doing their duty. The patient developed an abscess over the site of the wound, however. I took a number of pictures of the skeleton at this time and to my surprise I found the true pathologic nature, namely, the absence of bony structure throughout the whole skeleton, in spots more or less irregular, most pronounced in the long bones of the extremities. A portable extension apparatus was now fitted and by careful nursing and training we finally succeeded in enabling the patient to walk about the house with the aid of cane and crutch, whereupon she left the hospital for her home. A few months later her brother telephoned to me that his sister, while attempting to rise from a chair, had fallen and this time had broken her right healthy leg and her left arm. The doctor who was called gave a very bad prognosis. She could not move in bed without having the most excruciating pain in her arms and legs. I began to scan the literature and here the work by Bossi came to my notice, which treated of the study of osteomalacia. I had the young girl brought back to the hospital. She was in a very pitiable condition. Her left arm was so soft that I believe, had I anæsthetized her, I could have bent her humerus upon itself, so soft it seemed. The pictures show a total absence of the eburneous portion of this part, and only a faint, irregular shadow indicates where

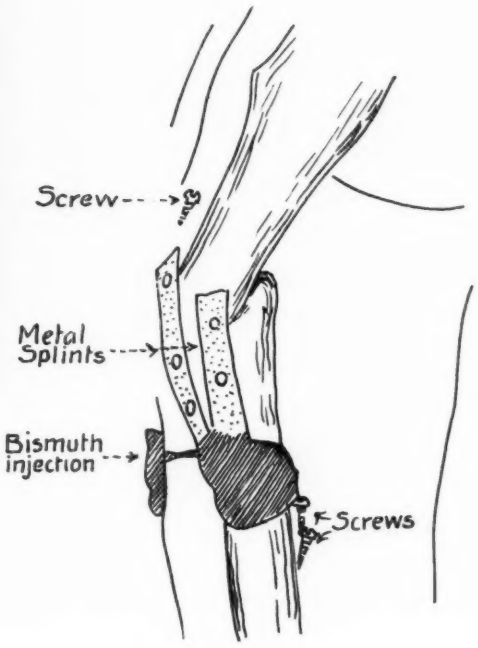


Fig. 8. Left femur after operation and treatment.

the bony structure was. The physical examination shows nothing abnormal. Urine and blood show nothing pathognomonic. I immediately began treatment with injections of ten drops of 1–1000 adrenalin. After the first injection the pain in her right limb ceased, and after the third injection (injections of twelve drops daily being made hereafter) the arm became tolerably painless and became stronger and stronger. After about a dozen injections the arm could be moved about as previous to the accident. I never was so struck by the efficiency of a drug as at this time. Altogether she received twenty-five injections. True, at times the injections caused very unpleasant symptoms, such as tremor, a rapid heart beat, but the condition was never alarming. After a number of weeks the patient left the hospital wearing a high shoe and is able to walk without a cane, and as you see here, also able to stand.

SUMMARY OF THE CASE

We have to deal here with a case of a young girl with a gradual softening of bones, due to absorption of lime salts, in areas of different size, some of them extending quite a distance, with a great tendency to fractures, with very little disposition to healing. The condition grows gradually worse until the largest portion of the skeleton, principally the long bones, are affected. With the injection of adrenalin the pathologic condition gradually shows clearly an increase of lime salts and gradual healing.

OSTITIS FIBROSA

In the Festschrift to the seventy-first birthday of Rudolph Virchow, Dr. Recklinghausen described a condition which he called ostitis fibrosa deformans. This pathologic condition of bones was characterized by the appearance of many whitish or brownish red, small tumors and cysts of the bones, with gradual deformation and distortion due to fractures and dislocation in the whole skeleton. Histologically he noticed the transformation of the bone marrow into fibrous tissue, hence the name ostitis fibrosa. Very often this fibrous tissue appeared with giant cells like a sarcoma. There have been a number of these cases of this rare disease reported (by Hirschberg, Schoenberger, and Rehn), since Rehn had a case on which he operated repeatedly. Weigert found giant cells in the tissue and consequently diagnosed the case as sarcoma. Rehn, however, regarded the case as one of ostitis fibrosa, that means an inflammatory change, with transformation of bone marrow

into fibrous tissue. Virchow and most of the observers have followed the theory regarding this condition as an inflammatory change. Pfeiffer describes in the Beiträge zur Klin. Chir., 1907, four cases of this comparatively rare condition, and states that it remains for a long time unobserved until some fracture or deformity following a fracture brings the case to the observation of the surgeon. Out of forty-nine cases recorded there have been twenty spontaneous pathologic fractures reported. From this disease must be differentiated a condition described by Ollier and his pupil Poncet, called ostitis and periostitis albuminosa; similar inflammatory changes are found due to staphylococci or tubercle bacilli (Sleelswijk and Vollert).

BONE CYSTS

For a long time cases have been reported as bone cysts and cystic degeneration of bone which pathologically were really different conditions. We ought not to use the term "cysts" as long as we know the true pathologic origin of a condition, but it is one of those inherited terms which will make their appearance in the literature as long as there is no better understanding of their origin. Cyst means an accumulation of liquid or semiliquid substances within a shell or wall, but since it often happens that pathologic conditions of different nature, inflammatory and tumors, undergo changes of regressive nature leading to liquefaction we often have to deal with accumulations of liquids or semiliquids in shells or walls belonging to the class of tumors or inflammation. The true cyst is one in which the wall is lined with an epithelium which secretes the fluid. Such cysts are common in the ovaries, but they are very rare in bones, in fact I do not know of any authentic case of such kind, except the bone cysts of the jaws and parasites. There have been different conditions observed in bones which have been called cysts, among other the following: 1. Ziegler describes small cystic formations under the cartilages of arthritis deformans. 2. Rindfleisch, C. C. Schmidt, and Mommsen have described cysts in osteomalacia. (Those are the same kind as in our case two of osteomalacia described above.) 3. Lubarsch describes small cysts in old individuals, particularly in the neighborhood of the hip-joint as of common occurrence. 4. The dental cysts; these are the only ones which are lined with an epithelium. 5. All degenerations of tumors and inflammations. 6. Parasites (echinococcus).

Of the variety of cystic formations of bones I have had one case which I have the chance to present to you to-night.

The history is as follows: I. H., was five years old when she was brought to me by her uncle, a physician, during the meeting of the American Medical Association, in Chicago, June, 1908. She had sustained a fracture of the hip by a fall, as I was told. She was seen by one of our foremost orthopedic surgeons who had a picture taken which revealed a very peculiar feature thought to be a tumor of the hip, perhaps a sarcoma, and the surgeon referred her to me for operation. The picture of the case showed an excellent skiagraph of a typical bone cyst, the trochanter major was considerably larger on the injured side and seemed to be deprived of its lime salts, leading to formation of small cavities, something like a honeycomb. An incision made over the trochanter and the knife entered easily into the softened bone structure which seemed to be transformed into several chambers filled with a reddish brown hæmorrhagic mass. This mass was evacuated and the part of the shell which seemed to be superflous was excised. It seemed as if there was only a small bridge of bone connecting the head of the femur with the shaft. A strip of gauze was introduced and the wound sutured. The child made an uneventful recovery, and was able to go home in about two weeks with a cast on her limb. A few months later she was on her feet and very soon learned to walk. X-ray pictures were taken at regular intervals and to-day it shows that the region has regenerated bone well enough to make a strong head to walk upon, though the angle of the head and neck and shaft of the femur approaches more and more the right angle and there is a shortening of about an inch and one-half. The child limps slightly but she has no difficulty in walking. The microscopic examination of the structure removed, showed a loss of lime salts together with large embryonal cells taking the place of bone cells, with a good deal of hæmorrhagic infiltration. No trace of a malignant growth could be found.

SUMMARY

We have to deal here with a case of cystic degeneration of the bone, or what is called bone cyst. The term does not fit exactly the pathologic condition, but we do not know enough about these conditions to classify them exactly and it will require a great deal of time and study to place these cases right.

I have in my possession a number of skiagraphs of conditions which are similar in many

respects to either one of these cases,— in other respects widely different, and I take an occasion to demonstrate a number of skiagraphs to show the changes without being able to explain the true nature of these pathologic conditions. They all have one symptom in common, however, the bones are very fragile, and consequently I place them under the term osteopsathyrosis, which means, however, nothing else but fragility.

THE INCREASE OF CANCER[1]

By WILLIAM B. COLEY, M. D., New York City, New York
Professor of Clinical Surgery, Cornell University Medical School

IT is a remarkable fact that a disease so widely prevalent as cancer and one that has from time immemorial held first place in the amount of suffering that it inflicts upon its victims, and is now approaching front rank in the number of those victims, should have received such meager attention from both local and national boards of health. Antituberculosis leagues have become universal, government boards of health and scientific medical bodies all over the world have long since instituted a well-organized campaign against the white plague, with results that even now justify the hope of speedy control with the possibility of ultimate conquest. While much has been written upon the question of the increase of cancer, many of the papers have been attempts to explain away the figures of the vital statistics, which in every civilized land during the last half century have shown a steady increase in the number of deaths from cancer.

The purpose of the present paper is to go over the evidence at present at our command, in the hope of arriving at some conclusion as to whether cancer is increasing or not.

Roger Williams in his recent book on the *Natural History of Cancer*, states that the disease has doubled in frequency in periods ranging from twenty to thirty years, the annual increase averaging from 3 to 5 per cent.

Williams refers to the unique statistical study of cancer made by Ekblom (*Hygeia*, January, 1902,) for the small Swedish town of Fellingsbro. Taking the average for the first and last decennial periods of the century, he showed that the cancer death rate increased from 2.1 per 100,000 living in the former period, to 118 living in the latter.

The only statistics in Great Britain which compare with these statistics as regards the period of observation, are those of the Scottish Widows' Life Insurance Fund (Edinburgh, 1902). The records of this Fund show the proportion of deaths due to cancer to the total mortality among males since 1815:

	Per cent
1815 to 1844	0.93
1845 to 1858	1.79
1859 to 1866	3.00
1867 to 1873	4.56
1874 to 1880	4.93
1881 to 1887	5.44
1888 to 1894	6.88

The records of the German Life Insurance Company strikingly confirm the foregoing figures. The cancer mortality among males from 1885 to 1889 amounted to 3.7 per cent of the total deaths, and among females to 11.4 per cent; from 1889 to 1895, however, the ratio was 11.4 for men and 12.9 for women.

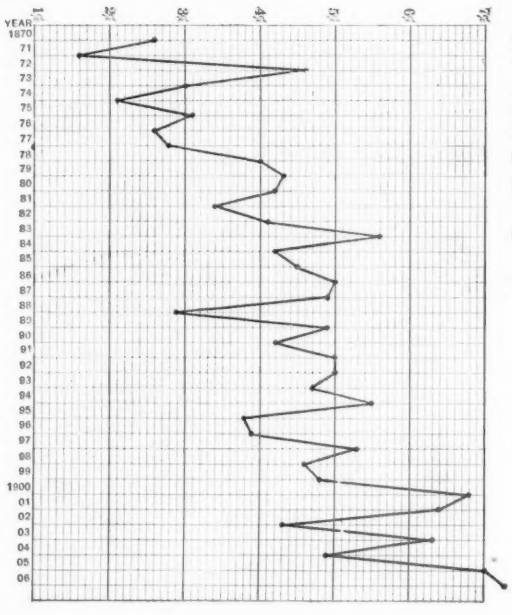
PERCENTUM RATIO OF DEATHS FROM CANCER TO TOTAL DEATHS. EXPERIENCE OF ÆTNA LIFE INSURANCE COMPANY OF HARTFORD, FROM 1870 TO 1906

(For which I am greatly indebted to Dr. E. I. McKnight and Dr. E. A. Wells, of Hartford, Conn.).

Year	Total Deaths	Deaths from Cancer	Per cent
1870	426	11	2.6
1871	432	7	1.6
1872	486	8	4.6
1873	579	18	3.1
1874	474	10	2.1
1875	527	16	3.0
1876	536	14	2.6

[1] Read by title before the Southern Surgical and Gynecological Association, December 14, 1909.

Year	Total Deaths	Deaths from Cancer	Per cent
1877	544	15	2.8
1878	502	20	4.0
1879	532	23	4.3
1880	542	23	4.2
1881	593	20	3.4
1882	565	23	4.1
1883	656	37	5.6
1884	645	27	4.2
1885	667	30	4.5
1886	715	36	5.0
1887	719	34	4.9
1888	783	23	2.9
1889	761	37	4.9
1890	817	34	4.2
1891	897	45	5.0
1892	1019	51	5.0
1893	1013	48	4.7
1894	956	53	5.5
1895	1052	40	3.8
1896	1029	40	3.9
1897	1044	55	5.3
1898	1051	48	4.6
1899	1114	54	4.8
1900	1215	83	6.8
1901	1303	84	6.4
1902	1267	55	4.3
1903	1386	87	6.3
1904	1432	70	4.9
1905	1388	97	7.0
1906	1514	111	7.3



In England and Wales the later statistics have separated the rural population from the urban. The cancer rate in the rural districts seems to have suffered much less than in the urban. Considerable difficulty, however, results from the fact that a number of rural cases of cancer go to the city for operation, thus adding to the mortality of the urban population by at least the number of such cancer patients as die from operation. It is probable that the majority of patients who come to the city for operation and recover return to their respective homes, where they remain until death.

During the last six years, in England and Wales, 176,019 persons died of cancer. Of these, 104,418 were females and 71,601 males. Of 10,000 males dying of cancer, 2,172 had cancer of the stomach; of 10,000 females, 2,259 had cancer of the uterus. Of the males who died of cancer in this period, 43,092 died of cancer of the intestinal tract; stomach, 15,553; intestine, 5,439; rectum, 7,277; œsophagus, 4,505; liver and gall-bladder, 9,328.

London, per 100,000: 1851 to 1860, 42; 1861 to 1870, 48; 1871 to 1880, 55; 1881 to 1890, 68; 1891 to 1900, 85; 1901 to 1904, 92.

Berlin, cancer and tumors: 1881 to 1885, 55; 1886 to 1890, 65; 1891 to 1895, 75; 1896 to 1900, 85.

French statistics show that the increase has been general, and not an increase of obscure internal or abdominal cases that could be accounted for by increased accuracy in diagnosis.

France, Denmark, Sweden, and Bulgaria, causes of death tabulated for towns only.

AVERAGE FOR TEN YEARS, 1896 TO 1905 PER 1000 LIVING

Switzerland	1.29
Netherlands	0.95
Norway	0.90
England, Wales	0.83
Scotland	0.81
German Empire	0.74
Victoria	0.72
Austria	0.70
New Zealand	0.63
Ireland	0.63
South Australia	0.61
Prussia	0.61
New South Wales	0.59
Tasmania	0.50

Italy	0.53
Queensland	0.50
Japan (average five years)	0.49
Spain (average six years)	0.44
Western Australia	0.38
Hungary (average seven years)	0.35
Servia	0.09
Ceylon	0.06

CANCER-DEATH RATES

Among the places showing the lowest death rate from cancer in the State of New York are. Hudson, 36.8 per 100,000; Little Falls, 175: per 100,000; Ithaca, 156 per 100,000; Johnstown, 115 per 100,000.

In New York City in 1908 the rate was 75.4 per 100,000.

The difference in the different boroughs of New York is noteworthy:

In the borough of the Bronx the rate is highest, being 95.8; it is lowest in Queens, namely, 68 per 100,000.

The mortality of the white and colored population, under the same conditions, in New York City is practically the same, viz., 75.4 white; and 71.8 colored.

The death rate of the colored population shows most extraordinary differences in the different boroughs: In Manhattan borough it is 57.5 per 100,000; in Bronx, 244; in Richmond, 150.

It is very difficult to explain these differences, especially as the general cancer death rate throughout the South is distinctly lower in the colored race than in the white. It is also lower in New York City in general.

The marked, constant, and general increase in the death rate from malignant growths in the twenty-eight principal cities of the United States from 1883 to 1907 is clearly shown in a paper by Roy F. Edwards.[1] These 28 cities, in 1883, with a total population of 6,097,585, showed 2,960 deaths, or a rate of 48.5 per 100,000 living. In 1895 the population of these cities was 9,157,682, with 5,377 deaths from cancer, or a rate of 58.7 per 100,000 population. In 1907, with a population of 12,524,695, there were 9,686 deaths from cancer, or a rate of 77.3 per 100,000. Thus, in a period of twenty-four years the death rate increased from 48.5 to 77.3 per 100,000.

These figures were taken entirely from local bureaus of vital statistics. Actually, the death rate from cancer is far greater than the rate shown by the vital statistics, for the reason that there is prevalent among the laity a strong prejudice against the name cancer, the result being that in many cases of death from cancer, especially metastatic cancer with internal complications, the family physician, out of respect for this feeling on the part of the family, will assign some of the secondary causes in place of the actual primary cause of malignant disease.

The great extent to which this is true has recently been shown by Gulliot, of Reims, France, who made a careful comparative study of the number of cases certified to have died of cancer, and the actual number known to have died of cancer in a given locality in a given period of years, and found that the number who had actually died of cancer was exactly double the number certified to have so died.

AMERICAN AVERAGE PER 100,000 POPULATION

Cancer. Registration area	1900-'04. 66.5	1901. 64.5	1902. 68.3	1903. 68.6	1904. 70.6	1905. 72.1	1906.	1907.
Boston	89.6	88.2	87.5	93.2	95.7	105.6	100.1	104.6
Massachusetts	83.0	82.0	86.7	85.0	86.3	92.9	90.3	93.5
San Francisco	124.0	115.2	128.3	125.3	134.3	125.0		
Indiana	47.0	44.0	47.0	49.0	50.0	55.0	53.7	57.1
Vermont	81.0	70.0	69.0	93.7	87.0	84.2	85.3	99.0
New York City	68.5	69.0	66.0	69.5	71.4	73.0	74.0	76.8
New Haven	...	...	...	79.4	71.9	92.4	83.3	100.5
Providence, R. I.	...	...	...	80.8	96.9	97.2	93.5	108.7

Registration area, 1900.....36,846,981
Registration area, 1907.....41,758,037
Estimated population, 1907.....85,532,761

LOWEST RATES OF CITIES IN THE UNITED STATES

Louisville, Ky.	50.1
Paterson, N. J.	56.1
Detroit, Mich.	65.0

HIGHEST CITIES

San Francisco	125.0
Boston	104.0
Providence	108.7
Lowest rates, Indiana, average 1901 to 1905	49.5
Highest rates Maine, average 1901 to 1905	86.7

Deaths from cancer registration area in the United States for 1907 were 30,514, or 1,494 more than in 1906, and a rate of 73.1 in 1907, compared with 70.8 in 1906. Estimated deaths from cancer in the United States for 1907 were 63,508.

[1] Medical Record, December 18, 1909.

"The crude death rates from cancer continue to increase, and slightly higher rates are recorded for each main subdivision of the registration area. For the year 1908, 33,465 deaths from this disease were returned, and the death rate was 74.3 per 100,000 of population, as compared with 30,514 deaths and a death rate of 73.1 for 1907."[1]

Schuster,[2] in his statistical study of carcinoma, shows the death rate from cancer between 1863 and 1867 to have been 7.14 per 10,000; from 1873 to 1877, 10.39; from 1893 to 1897, 12.21; from 1903 to 1907, 14.76.

According to *K. Sato*,[3] of 64,030 patients treated in Japanese hospitals, 1,372, or 2.14 per cent, suffered from cancer. The proportions in which the various organs were affected are as follows: Uterus, 33.53; stomach, 32; intestines, 6.2; breast, 5.69; skin, 2.17; œsophagus, 1.53 per cent.

Various attempts have been made from time to time, particularly by Newsholme and his followers, to question the reality of the increase of cancer. Some have declared it due simply to the increase of population, but, as Williams has pointed out, while the population of Great Britain doubled between 1850 to 1905, the cancer mortality increased six times.

Another explanation of the increase of cancer which has been more widely accepted is, that during recent years, due to improved hygienic conditions, a larger number of people have reached mature life, or the cancer age, and for this reason a larger number would be affected by cancer. Williams' reply to this is that the saving of life in modern times has been almost entirely confined to the precancerous period, the death rates of males over thirty-five years and of females over forty-five years having remained almost stationary, while the proportion attaining old age has decreased.

The objection so strongly urged by Newsholme is that the increase of the cancer death rate is due chiefly to improved methods in diagnosis.

This objection was answered many years ago by Mitchell Banks, one of the most careful students of cancer in Great Britain, and a man of wide experience. Banks stated that while the diagnosis of cancer in its early stages is probably made much more frequently now than in former times, it required little skill to make the diagnosis at the time of the death of the patient. The diagnosis at such a time was by no means beyond the ability of even the rural practitioner of fifty years ago.

Williams further points out that the increase has been far too uniform and steadily progressive during this long succession of years to leave any basis for such an argument, and, taking the increase over the entire period, he believes it to be so enormous as to make the explanation seem far-fetched. While it is possible that improved methods in diagnosis may add slightly to the total cancer death rate, Williams points out that these very improvements in diagnosis may also cause subtractions from it, and he shows that in the report of the Registrar-General as late as 1880 such diseases as fibroid tumor, polypus, and lupus were usually classed as cancer. Since then these diseases, as well as a number of other conditions at one time regarded as malignant, have been assigned to other causes.

A careful study of the whole subject shows the increase to be a general one and not limited to a few parts of the body. In other words, intra-abdominal or inaccessible cancer, which would be the type most likely to be affected by improved methods of diagnosis, shows even less relative increase than external cancer. In 1868 the death rate for cancer of the stomach per 1,000,000 living, thirty-five years and upward, was 283.65 for males and 193.45 for females. In 1888 the rate had increased to 346.15 for males and 277.75 for females, making an increase of 22 per cent for males and 44 per cent for females; but in this particular period the death rate of cancer in general had increased 50 per cent.

The greater death rate of malignant disease in women is due to the large number of cases which occur in the breast and the uterus. In all other localities the liability in the male is much greater than in the female.

Cancer has already increased to such an extent that at the present date it causes more deaths among women than tuberculosis, in 1905

[1] Department of Commerce and Labor, Bureau of the Census, 1908, Bulletin No. 104.

[2] Zur Carcinom Frage, Bamberg, 1909.

[3] Gann, Results of Cancer Research in Japan, 1907.

the rate being 100 cancer deaths to 94 from tuberculosis. Even taking men and women together, and at all ages, the death rate from cancer is rapidly approaching that of tuberculosis. From 1851 to 1860 the death rate per 1,000,000 living was 317 for cancer, 2,676 for phthisis, and 807 for other tuberculous disease; while from 1891 to 1900 the rate was 754 for cancer, 1,391 for phthisis, and 619 for other tuberculous diseases.

That the death rate of cancer is often much higher among the rich and well-to-do is shown by some of the Irish statistics. In prosperous Armagh the rate was 104, while in poverty-stricken Kerry it was as low as 26.

In Switzerland we have a low tuberculosis mortality, but an exceedingly high cancer death rate; and even here the rate is steadily increasing, having risen from 114 in 1889 to 132 per 100,000 living in 1898. Here two-thirds of the people are engaged in industrial and commercial work and only one-third in agriculture.

Williams states there are no millionaires in Switzerland and no paupers; prosperity is more widely diffused than even in France.

In Denmark the mortality from cancer is 130 per 100,000 living, with a phthisis rate of 150.

In studying the statistics of France we have to consider that they are based entirely upon urban population, excluding the rural populace, thus covering only 12,000,000 out of a total of 39,000,000. The population of France has remained relatively more stationary than in most other countries of which statistics exist, and yet the death rate of cancer shows the same constant increase as elsewhere. In Paris the death rate of cancer in 1865 was 84; 1870, 91; 1880, 94; 1890, 108; 1900, 120.

The towns above 10,000 show, in 1887, 76; 1890, 91; 1895, 100; 1900, 106.

In Australia the death rate per 100,000 living has been as follows: In 1851, 14; 1861, 19; 1871, 25; 1881, 32; 1891, 45; 1901, 57.

The Australian statistics show a remarkable difference between the Australian-born and British and foreign population. Of the former, 58 in 100,000 living died of cancer, as against 137 of the British and foreign-born.

There is much difference of opinion as to the frequency of cancer in China, but there is no question that the Chinese in other parts of the world suffer severely from the disease. In 1900 the rate among Chinese in Australia was 72 in 100,000. On the other hand, among the Australian natives, i. e., the aborigines, which in 1891 numbered 60,000, cancer is very rare.

Medical men who have lived among the Pacific Islanders for many years state they have never seen a case of cancer.

In Ceylon and Java the cancer mortality is very low. This, however, may be partly explained by the fact that the death statistics are very incomplete, the causes of death in the large majority of cases not having been medically certified.

In nearly all the countries from which reliable returns have been obtained the cancer mortality has shown a general tendency to increase in recent years. On the other hand the statistics of tuberculosis show 56,841 deaths, or 6,041 less than the average for ten years.

The cancer statistics of last year show 31,668 to have died of cancer in England and Wales, being 2,882 more than the average for ten years, the male increase over the decennial average being 16 per cent, the female increase 6 per cent, making 794 deaths from cancer per 1,000,000 living males and 732 for females, both being the highest rates on record.

A careful analysis of the statistics of cancer that are obtainable at the present time forces one to the conclusion that there is a constant and considerable increase in the number of people afflicted with cancer in all civilized countries. How can we best explain this increase?

The pathologists together with the clinicians who accept Cohnheim's theory as the true explanation of the cause of cancer try to explain this increase of the cancer mortality by changes in the mode of living as compared with previous years. Many, like Roger Williams, believe that the increased consumption of nitrogenous food has much to do with the increase of cancer. Attempts have been made to show that it is more prevalent among the rich and well-to-do than among the poor and ill-fed. A careful study of the cancer statistics, however, does not fully bear out this assumption. Some

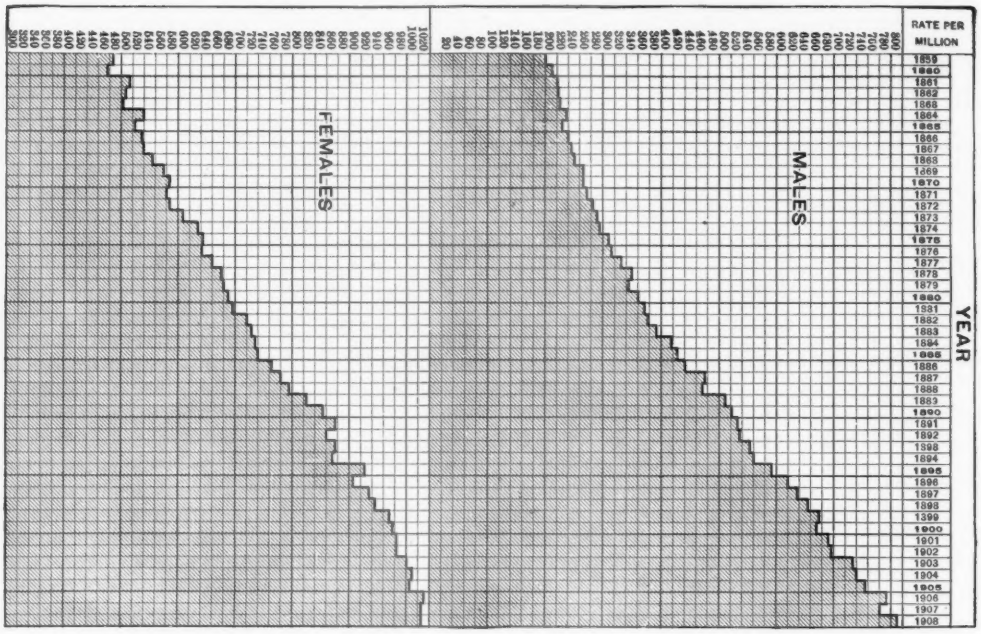


Table showing increase of cancer in England from report of Registrar General, 1908.

of the districts in which the cancer mortality is the highest are rural districts, in which the people live in a very simple manner. Some writers attribute a high cancer mortality to luxurious living, especially to large consumption of meat and alcohol. This is hardly true, as the mortality of Copenhagen, 138 per 100,000, is nearly double that of London, Paris, or New York.

My own feeling is that the most rational explanation is to assume that cancer is of extrinsic or microbic origin.

New evidence in favor of the endemic and, possibly, infectious nature of cancer, is found in a paper on "Cancer in New Zealand," by Hyslop and Fenwick.[1]

They state that although New Zealand has the lowest death rate for the world, there is, nevertheless, a persistent increase in the percentage of deaths from cancer. In the year 1898 the rate per 100,000 living was 64; in 1907 it was 73. The alimentary tract was the seat of invasion in the great majority of cases of both males and females. In males the stomach was the seat of the cancer in 32.5 per cent of the total number; intestine and rectum, 10.8 per cent; liver, 11.8 per cent. In the females: stomach, 21.9 per cent; intestine and rectum, 12 per cent; liver, 16 per cent.

One of the writers collected 31 cases of cancer which had come under his personal observation in his own district, and found that of 16 male cases, 11 occurred in the bowel.

Dr. Hyslop describes at length the topography of the district in which his cases were observed — a flat tract, lying between a snowfed river and a smaller stream. A large portion of the district is seasonally flooded by these streams, and the high mortality from cancer is in harmony with the conclusions of Haviland, based on a careful study of the geographical distribution of cancer.

It is of further interest to note that 6 of the 31 patients all lived in the same house. These 6 persons were all shepherds, agricultural laborers, or farmers, and they were not related by blood, thus entirely excluding the element of heredity.

As regards the habits of the patients, all

[1] British Medical Journal, October 23, 1909.

drank tea with their meals three times a day, and nearly all of them had meat three times a day.

The great variation in the death rate from cancer in the different parts of New Zealand is also interesting:

Dr. Britton, who at one time practiced at Ross, on the West Coast, found from his note-books and death certificates that during a practice of three years he had 35 deaths. Of these, 20 were under nine years of age; the remaining 15 between ten and seventy-eight years; in 5 of these, or 33.3 per cent, death was due to cancer. While in his ten years' practice on the East Coast his records showed 71 deaths, only 1 of which was due to cancer.

CONCLUSIONS

A great mass of evidence, based upon vital statistics, shows a well-marked and steady increase in cancer in practically every civilized country.

Attempts to explain away this increase as an apparent and not a real increase are far from convincing.

Without any further increase the present death rate from cancer is appalling.

Furthermore, the actual death rate from cancer is much higher than the known rate, by reason of the fact that in many cases of patients dying from internal metastases the strong prejudice of the relatives against the name of cancer is respected by the family physician, and some secondary cause of death appears in the certificate, instead of the primary cause, cancer.

The object in pointing out the ravages of this disease is to awaken a more profound interest on the part of the laity as well as the profession in cancer problems. Physicians can help toward the solution of this problem by making a careful study of every case of cancer that comes under their observation, recording every fact. When collected in sufficient numbers, such facts may throw some light upon the etiology of the disease and help to settle the vexed questions of heredity and contagion.

The pathologists are already deeply interested in the study of cancer, but the laboratory studies alone of cancerous tumors can never solve this great problem of the cause of cancer. The problem must be attacked from all sides — the clinical as well as the laboratory.

Once aroused to the importance of this problem the laity will lend its support by way of greatly increased endowments for cancer research work, and better and more efficient co-operation of state and national boards of health will follow.

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ON THE VALUE OF THE SHADOWGRAPH URETERIC CATHETER IN THE DIAGNOSIS OF OBSCURE LESIONS OF THE URINARY ORGANS [1]

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THE value of the shadowgraph ureteric catheter, and its permanent place in our diagnostic armamentarium is conceded by all whose work brings them in contact with cases presenting obscure lesions of the urinary tract. Not only is this method of value in cases presenting distinct lesions of the urinary tract, but it is particularly valuable in cases in which the symptoms are located on the right side of the abdomen, and therefore calling for a differential diagnosis between appendicitis and stone in the right ureter.

This method of diagnosis was first reported by Schmidt and Kolisher of Chicago in 1901. Although this method is of very recent origin, its value has been demonstrated many times over; it has been of service in making a diagnosis in many obscure cases in which the diagnosis could not have been established without it, and this applies particularly to borderland cases that could not have been cleared up with the X-ray alone or with cystoscopy and the ureteral catheter.

A few remarks on the technique may not be out of place. Before the cystoscopic end of the work is undertaken it is of course necessary for the Roentgen apparatus to be in perfect working order, and the operator ready to proceed with his exposures. It is very desirable to have the patient take a brisk cathartic the day before, so as to have the bowels well emptied before proceeding with the X-ray work. The usual preparations as for an ordinary cystoscopic examination are carried out. For catheterization I have always used an ordinary ureteral catheter armed with fuse wire. This is soft and pliable, therefore permitting the catheter to easily follow the ureter in its entire course without causing any deviations in it, as could be the case if a fine nonpliable wire were used. There is no step in the entire procedure which does not permit one to carry out the most rigid kind of asepsis. I usually sterilize the fuse wire by allowing the wire to remain in an antiseptic solution, employing for this purpose the germicidal disks of Parke, Davis & Co. These do not corrode the wire. Before inserting the wire into the catheter care should be taken to see that all of the antiseptic solution has been removed from it by wiping it dry with a sterile piece of gauze. A small amount of sterile glycerine may be used as a lubricant to aid in passing the wire into the lumen of the catheter. After the catheter has been removed at the end of the examination, the wire should be withdrawn immediately, lest it becomes firmly adherent to the inner side of the catheter, and hence rendering further sterilization of the catheter impossible.

Shadowgraph catheters may be conveniently divided into two groups:

1. In the first group may be placed catheters which owe their shadow producing qualities to the presence of bismuth subnitrate or cinnabar; these substances are usually mixed with the varnish or shellac that is used as a coating on the outside of the catheter. Cinnabar was first suggested by Goebell.

2. In the second group the shadow producing quality is due to the presence of a stylet in an ordinary ureteral catheter. Various agents have been recommended for this purpose, such as, for example, silver wire, fuse wire, or copper wire.

Lesions in the right lower quadrant of the abdomen very often give rise to obscure symptoms; this frequently necessitates making a differential diagnosis between appendicitis and stone in the ureter.

This differential diagnosis is not always very easily made especially in those cases of appendicitis accompanied by the presence of blood in the urine, and in which very fre-

[1] Read by invitation at the meeting of the Chicago Surgical Society, April 8, 1910.

quently a diagnosis of stone in the ureter is made. As an example of the difficulties arising in this class of cases I should like to mention the following case:

CASE 1. Mr. C., referred by Dr. Frank Wright, July 10, 1909. In December, 1908, the patient was seized with a severe attack of pain in the right side of the abdomen accompanied by fever and rigidity of the abdominal wall. He was free from symptoms until June 8, 1909, at which time he had another attack of pain in the abdomen accompanied by rigidity of his right side, a temperature of 99+°, vomiting and frequency of urination. This attack lasted for eight days. At the end of the second day the temperature came down to normal, *but the frequency of urination persisted.* At this time Dr. Wright found red blood cells present in three different specimens of urine that he had examined microscopically.

Just before leaving the hospital the patient had another attack of pain. During this attack he would urinate from two to three times every hour during the day, but he was never obliged to urinate at night. During urination he had pain in the urethra. The patient states that during this attack the pain started in the region of the right kidney and radiated down into the pelvis. At times the pain would radiate to the opposite side of the abdomen.

Each attack of pain, except the first, was associated with frequency of urination, and the presence of pus cells in the urine.

Physical examination. The rectal examination was negative. Head, neck, and chest were negative. A definite point of tenderness was elicited one fingerbreadth below the last rib on the right side and about four inches from the spine. A second point of tenderness on pressure was found about one fingerbreadth above McBurney's point.

This case is interesting from the standpoint of differential diagnosis and illustrates the difficulties arising in the differential diagnosis between appendicitis and stone in the ureter on the right side. There were present in this case symptoms suggesting appendicitis, namely, right sided pain, tenderness, rigidity, as well as a slight rise in temperature. The frequency of urination, pain in the urethra during urination, presence of pus in the urine and the demonstration of red blood cells in the urine were highly suggestive of stone in the ureter.

After a careful consideration of the subjective symptoms, and the tenderness above McBurney's point in front and the tenderness under the last rib behind, we decided that an X-ray picture be taken after a shadowgraph catheter had been passed up to the right kidney. Because of the extreme nervousness of the patient and of the sensitiveness of the urethra and bladder it was decided to administer a general anæsthetic. Cystoscopy was easily carried out. The bladder was normal; a catheterizing cystoscope was then introduced and the ureteral catheter passed into the right kidney without any difficulty. No obstruction to the passage of the catheter was met with. The X-ray picture was taken by Dr. Hollis E. Potter. It shows the cystoscope in the bladder. The shadowgraph catheter can be seen passing from the cystoscope toward the wall of the pelvis and upward along the usual course of the ureter. No stone shadows were found anywhere along the ureter, and a diagnosis of appendicitis was made.[1] At the operation a retrocæcal appendix was found bound down to the ureter by many adhesions. Appendectomy. The patient made an uninterrupted recovery and has been free from symptoms ever since. See Fig. 1.

CASE 2. Mr. J. M., aged 60. Referred by Dr. Wm. Hessert. Ten years ago the patient was suddenly seized with very severe pains in the right upper part of the abdomen. This attack was first diagnosed as appendicitis but was changed by the attending physician to renal colic. Following this attack he passed a flat stone, about the size of a pea, through the urethra. After this attack he enjoyed good health up to four years ago, at which time he again began to have pain in the right side of the abdomen. This attack subsided quickly under the use of hot fomentations. The patient never noticed any blood in the urine. The present attack began four days prior to admission to the hospital, with a feeling of weakness and pain in the right upper quadrant of the abdomen. The pain is of a short character and associated with a dragging sensation in the right testicle. During this attack there have been no urinary symptoms, such as painful or frequent urination, and there has been no stoppage of the stream. Neither nausea nor vomiting.

Examination of the abdomen. The abdomen is rigid. The area corresponding to the right kidney presents distinct localized tenderness. There is no tenderness over McBurney's point, nor is there any lumbar tenderness.

Urinary examination. Cloudy, straw, 1020, acid. Alb. + casts, red blood cells many.

X-ray examination. Several X-ray pictures were taken and they all showed the presence of several shadows in the pelvis; it was then decided to take another X-ray picture with a shadowgraph catheter in the ureter to determine the origin of these shadows. Cystoscopic examination of the bladder was negative. The ureteral orifices were normal. The shadowgraph catheter easily entered the orifice and was advanced

[1] X-ray pictures were also taken of both kidneys which were negative as regards the presence of stones.

without meeting any obstruction. An X-ray was now taken and shows that the shadows are of extraureteral origin, therefore excluding ureteral stone. See Fig. 2. X-ray examination of the kidneys was negative as to stone.

The really interesting feature of this case is revealed by the course of the ureter as shown by the shadowgraph catheter, which, instead of passing upward out of the pelvis and parallel to the spine upward to the kidney region, passes inward toward the median line. From here the catheter passes upward and outward and stopping above the crest of the ileum. This kink in the ureter forms almost a right angle. See Fig. 3.

In this case the shadowgraph catheter was of double value. It excluded the possibility of the shadows seen in the pelvis being caused by stones in the ureter, and secondly, by demonstrating the low position of the kidney, as well as the abnormal course of the ureter. The pathological course of the ureter and the low position of the kidney can easily be called upon to explain the patient's symptoms. The patient refused operative treatment.

In the previous case the shadowgraph catheter was of value in excluding the shadows in the pelvis as being due to ureteral stones. In the following case its value in demonstrating the shadow first seen as being of an intraureteral origin, can be appreciated by referring to Fig. 4.

This case[1] has been reported in detail by Dr. Bevan and myself a short time ago. Patient, a male, age 52, who entered the service of Dr. Bevan at the Presbyterian Hospital, December 5, 1908, states that four years ago he first noticed disturbances in micturition at which time he was unable to void urine for a long time, and at other times he would have attacks of frequency of urination. During these attacks of frequency of urination he would pass small amounts of urine. During these attacks he also complained of severe abdominal pain in the left lower quadrant of the abdomen. The pain would last for three or four hours and then pass away very suddenly. While in these attacks he would feel nauseated, but he never vomited. The patient states that when suffering these attacks his urine was turbid. For the past eleven months the patient has felt a pain or discomfort in the left lower quadrant of the abdomen and when the pain was severe it would radiate toward the kidney and bladder. Patient has not lost weight and has been able to work most of the time.

[1] From the surgical clinic of Dr. Arthur Dean Bevan, Rush Medical College, Chicago.

Physical examination. Head, neck, negative. Heart, normal borders, no abnormal tones. Lungs, negative. Abdomen: No tenderness over the bladder or kidneys. Tenderness may be elicited by firm pressure in the left lower quadrant of the abdomen. Rectal examination, negative. Blood examination, hæmoglobin 93 per cent. Leucocytes 8,350. Urinary report: color red, physical condition turbid; specific gravity 1,020; sediment, no casts found; epithelial cells, leucocytes, and red blood cells present.

Cystoscopic examination. This shows a slight amount of injection of the vessels of the trigone. Internal urethral orifice negative. On account of the location of the pain on the left side and owing to the fact that the suspicious shadow was found on the left side, it was decided to catheterize only the left ureter. For this purpose a ureteral catheter armed with fuse wire was used, and passed into the pelvis of the kidney without meeting any obstruction.

A second X-ray picture was now taken with the catheter in the ureter, by Dr. Hollis E. Potter. Upon examining the skiagram, the catheter can be seen passing along the bulbous and posterior urethra through the bladder, passing toward the lateral wall of the pelvis and upward toward the kidney region. In the pelvic portion of the ureter and lying internal to the catheter the shadow produced by the stone can be seen; these findings absolutely established the diagnosis of stone in the ureter. The stone was removed by Dr. Bevan who approached the ureter extraperitoneally using the same incision as the one used in ligating the common iliac artery. The patient made an uneventful recovery and left the hospital at the end of two weeks.

As an illustration of the value of the shadowgraph catheter in the diagnosis of Dystopic pathologic kidneys, I would like to mention the following case,[2] recently reported by Dr. Arthur Dean Bevan in the Journal of the A. M. A. on February 26, 1910.

In April, 1903, the patient complained of pain in the legs and general weakness which lasted until the summer, when he took a rest cure. In July, 1903, the patient had his first attack of pain in the right side of the abdomen. Later a rough ride increased the pain very much. On November 12, 1903, the patient had an attack of very severe pain extending from the right side of the lower part of the abdomen to the right testicle. The pain was relieved by hot fomentations. Nausea and vomiting were present. Tenderness was elicited on deep pressure in the region of the appendix or below. An exploratory laparotomy, performed two or three days later, showed the kidney to be lower in position than normally.

Following the operation there was comparative freedom from symptoms until January, 1905, when he had another attack of severe pain, of the same character as before the operation. Since then there have been

[2] From the surgical clinic of Dr. Arthur Dean Bevan, Rush Medical College, Chicago.

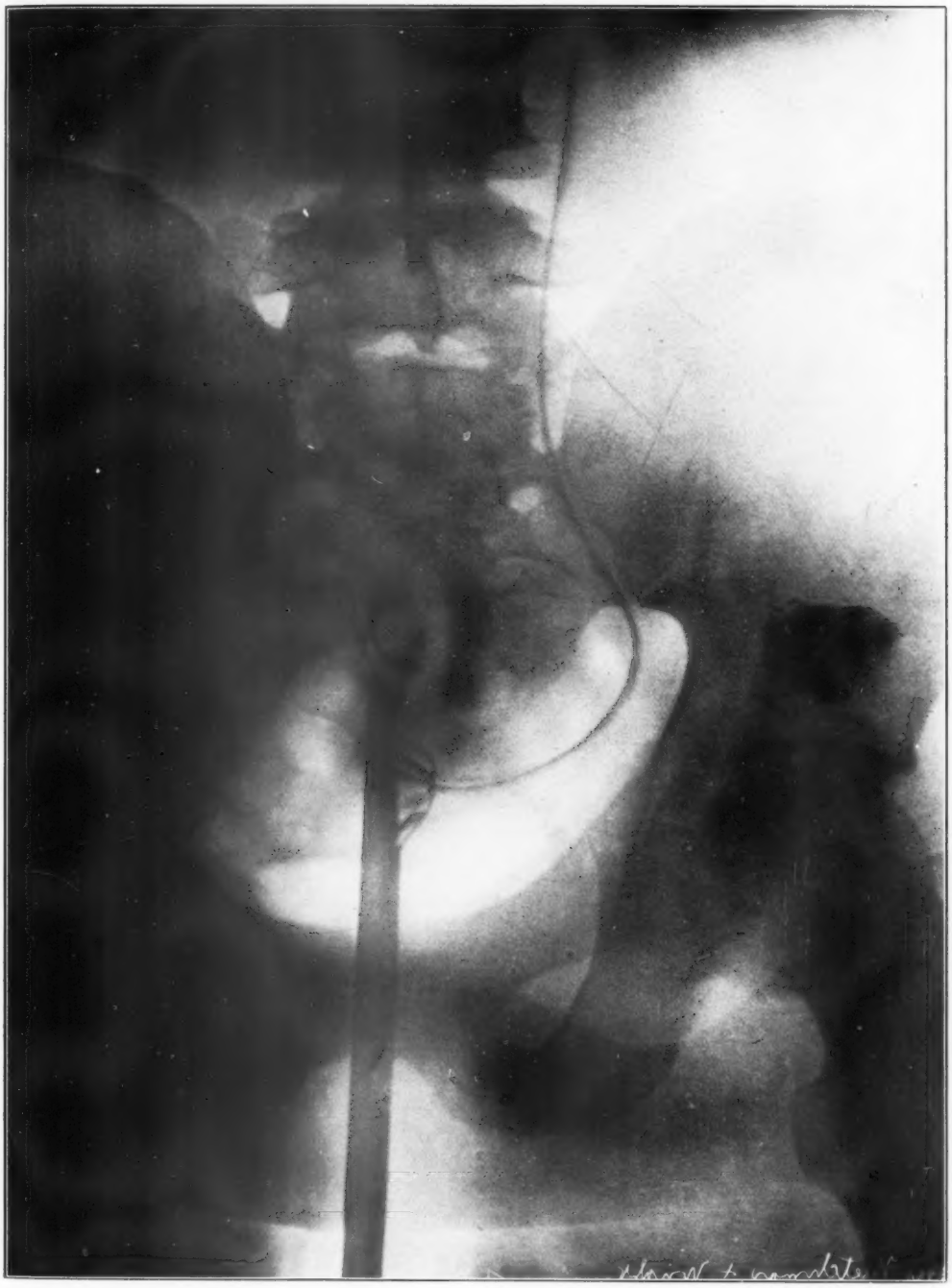

Fig. 1. To illustrate case 1. Differential diagnosis between appendicitis and stone in the right ureter.

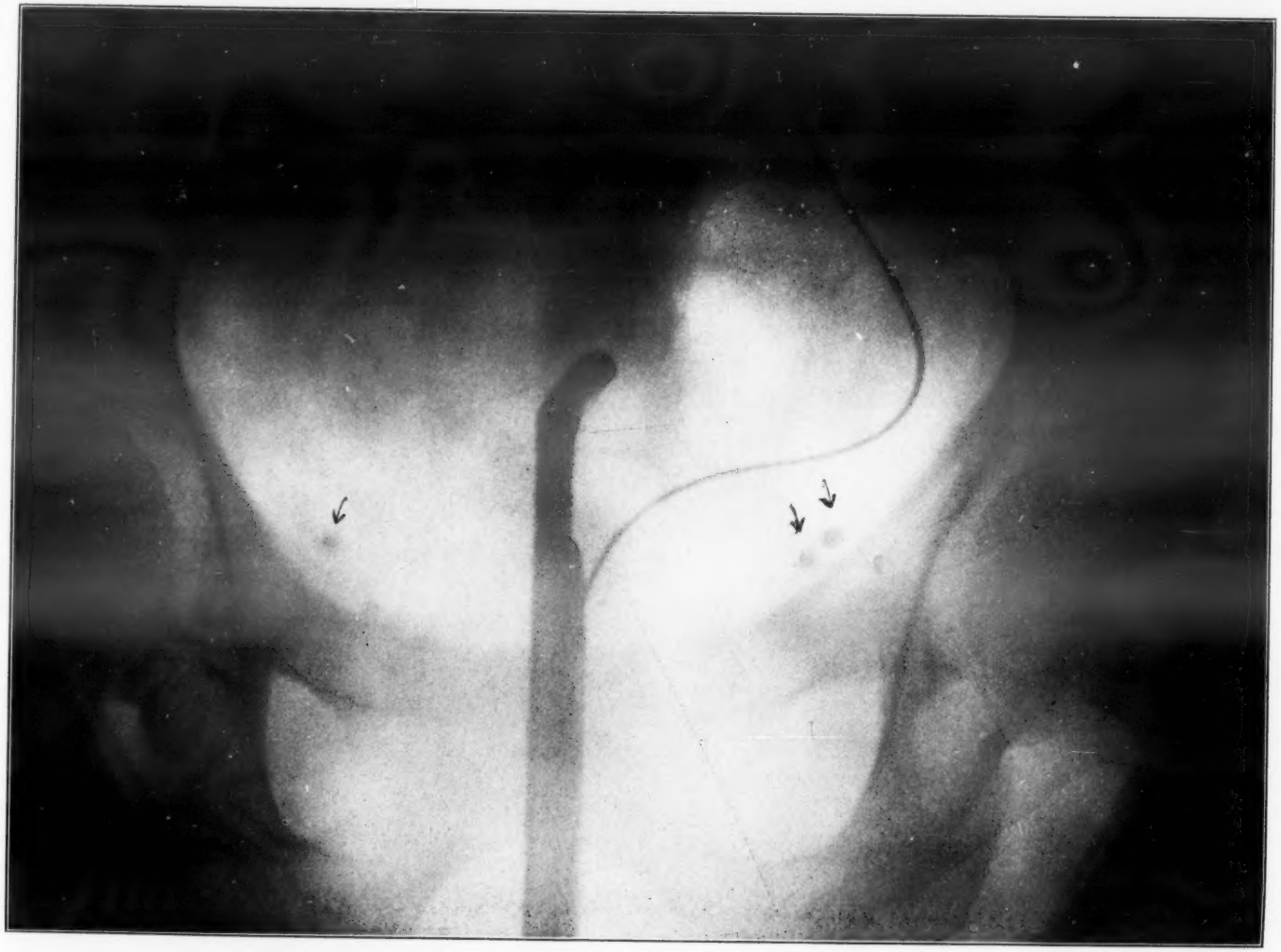

Fig. 2. Case 2. Arrows point to suspicious shadows in the pelvis. Excluded as being of intra-ureteral origin by the shadowgraph catheter.

Fig. 3. Case 2. To illustrate the course of the ureter, noting (a) the bend in its course near the spine, and (b) termination of the shadowgraph catheter just above crest of the ileum.

two attacks of severe pain and many darting pains in the troubled area. Blood was noted in the urine six or eight times.

PHYSICAL EXAMINATION

Head, neck, and chest negative. Abdomen, a three inch scar is present in the median line below the umbilicus. Below and to the right of this scar is a mass that can not be definitely outlined by palpation. The mass is immovable and not tender.

The patient re-entered the Presbyterian Hospital on May 17, 1909. Principal complaint on re-admission was pain in the legs which has been present since 1903 and which comes on without any relation to exercise. He has had several attacks of pain localized in the right lower quadrant of the abdomen, not at McBurney's point. One attack in April, 1906, was quite severe, lasting for two or three hours with retraction of the right testicle. Occasionally he noticed some stinging and burning on micturition.

The X-ray picture, taken by Dr. Potter, showed the presence of a shadow the size of a hickory nut, compatible with that of a calculus just below the promontory of the sacrum; stereoscopic views were then made, which showed that the shadow producing mass was situated in front of the sacrum. On one of the projections the mass was seen about an inch to the right of the median line, which corresponded exactly to the point of tenderness.

On account of the right-sided pain and in view of the fact that one of the projections showed the shadow on the right side, it was decided to catheterize the right ureter with a shadowgraph catheter and demonstrate the course of the ureter by the X-ray. The catheter entered the ureteral orifice easily and advanced without any obstruction about one-third of its usual distance, when an obstruction was met and further advance was impossible. After an X-ray was made it was seen that the catheter, instead of proceeding across the synchondrosis in its usual path to the kidney swerved inward to the median line and stopped immediately in front of the shadow. See Fig. 5. After a careful study of the X-ray plate a positive diagnosis of stone in a dystopic kidney was made.

This case brings up the question of diagnosis of dystopic kidneys. Dystopic kidneys are usually of congenital origin and in as much as the case under consideration was of this type, I will consider only the congenital cases. Until recently but little attention was paid to this lesion of the kidney, from a clinical standpoint, and hence the diagnosis before operation has not very often been made. Usually some other pathological condition is suspected and diagnosed, only to have the true state of affairs revealed at the time of operation. (Laparotomy.) It is believed by many authors that congenitally misplaced kidneys are very prone to undergo pathological changes.

In this case a stone was present. The symptoms produced by congenitally misplaced kidneys are very variable. Chronic constipation and backache have frequently been met with. Severe mental disturbances occurred in a case of Israel's as well as in one of Albrecht's cases, and they lay stress upon its presence; they do not look upon the mental symptoms as a purely accidental association. When a dystopic kidney is present in women it has been alleged that it may interfere with menstruation and labor. That this is not always the rule is illustrated by the following case, reported by Lowit:

Patient, female, age 49. Menses began at the age of 13, always regular and of the twenty-eight day type The patient has had six normal deliveries the last ten years ago. Since then she has always been perfectly well. The patient was suddenly seized with severe pains in the lower part of the abdomen, and vomiting. No urinary symptoms, no trouble passing gas or fæces.

Physical examination. Revealed the presence of a smooth, round, not tender, apparently fluctuating, movable tumor. The result of the vaginal examination led to a diagnosis of tumor of the left ovary.

Operation. Laparotomy. After opening the abdomen a retroperitoneal tumor was found and removed, which proved to be a hydronephrotic kidney. Beside the presence of the retroperitoneal tumor, examination of the internal genitalia showed the presence of a uterus bicornis with rudimentary tube and ovary.

In this case the dystopic kidney was associated with the above mentioned congenital anomalies of the internal genitalia. The occurrence of congenital malformations of the internal genitalia with congenital malformations of the urinary tract are well known facts and have been carefully described by Paultauf, Rosthorn, and others.

The all important point in this class of kidney lesions is the question of establishing the diagnosis prior to operation, so that the type of operation to be carried out in a given case can be determined *prior* to the operation. In this case the diagnosis was absolutely established before the operation (stone in a congenitally misplaced kidney), and hence an extraperitoneal operation was carried out.

The operation was performed by Dr. Arthur Dean Bevan. A muscle splitting incision was used, the incision being carried down to the peritoneum, approaching the kidney extraperitoneally. The stone was removed through

Fig. 4. Case 3. Showing the presence of a stone in the ureter.

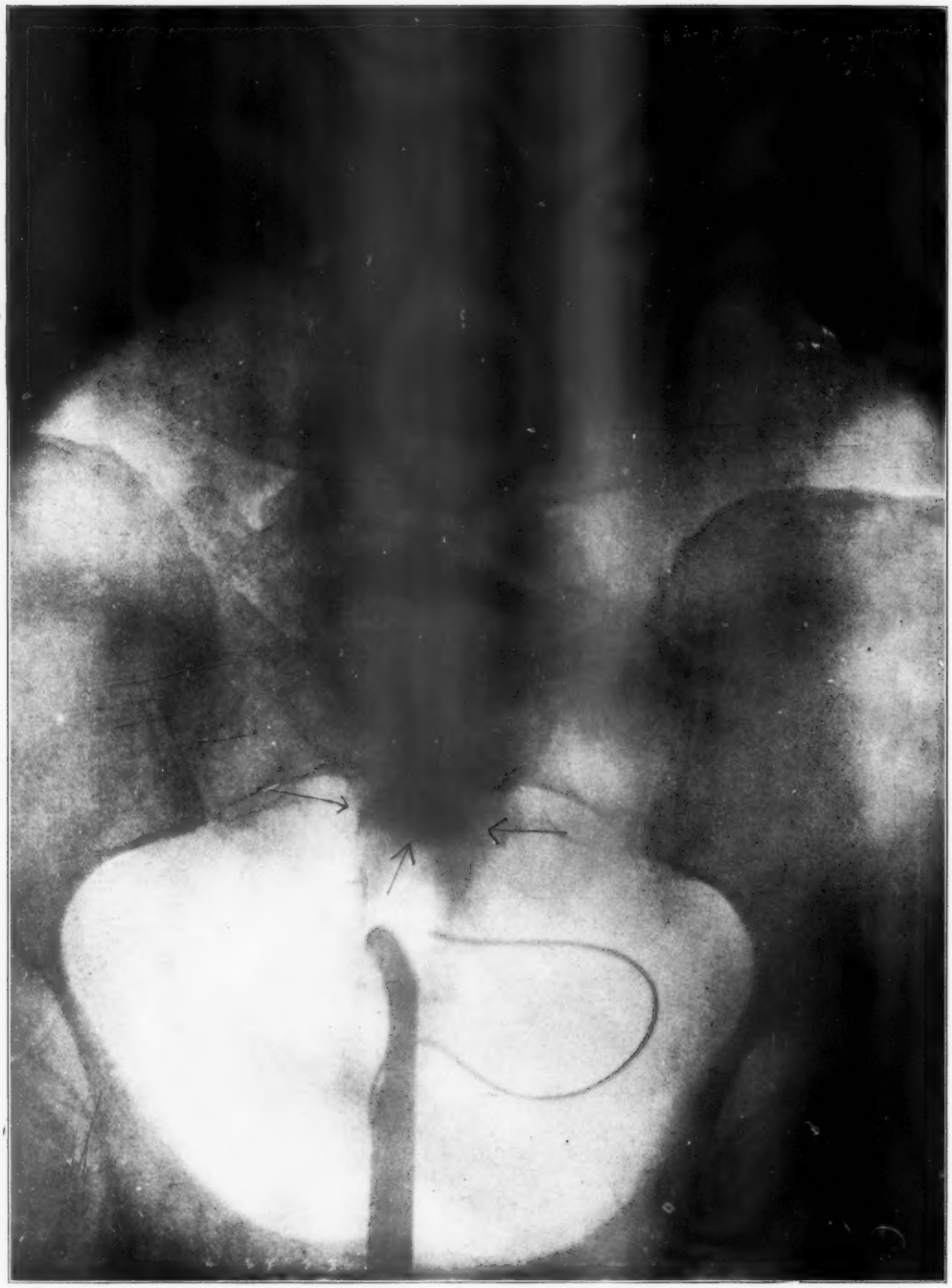

Fig. 5. To illustrate case 4, stone in a congenital dystopic kidney. Note (a) arrows pointing to shadow of stone over sacrum, and (b) the course of the ureter.

a pyelotomy incision. Closure of the incision with catgut sutures. Small cigarette drain placed down to the pelvis of the kidney. Musculature closed with catgut. The patient made an uninterrupted recovery.

A positive diagnosis in these cases must be difficult when based on the symptoms and the physical signs. Various rules have been laid down with this object in view. Wehmer mentions the following:

1. Demonstration of a tumor lying on the sacrum or the promontory.

2. Positive demonstration of the absence of the kidney on the same side.

3. Temporary occurrence of pyuria or hæmaturia associated with "Blasenzwang" particularly occurring with the menses.

4. Demonstration of an abnormal course of the rectum by means of air dilatation.

5. Excluding the origin of the tumor coming from other pelvic organs by means of palpation.

To these Hochenegg has added:

6. Demonstration of a palpable pulsation on the anterior surface of the tumor.

7. Demonstration by means of a ureteral catheter of an appreciable difference in the length of the ureters.

Standing out in a most marked contrast to these many doubtful and unreliable symptoms and signs, as well as the resort to an exploratory laparotomy, for a retroperitoneal condition, is the use of the shadowgraph catheter. By its employment in a doubtful case, we can absolutely and positively establish a diagnosis of a dystopic kidney. Whether the condition is of congenital or acquired origin can then be determined at the time of the operation. Measuring the length of the ureter as recommended by Hochenegg, has a loop hole through which an error may creep in and that is namely, in those cases of movable kidney which have later on become fixed. In this class of cases naturally there is no difference in the length of the ureters and the mass in the pelvis may still be kidney, although showing the same length of both ureters. This error may be overcome by resorting to the use of the shadowgraph catheter combined with the X-ray, in which event the catheter disregardless of its length would show the course of the ureter and its relation to the mass in the pelvis.

In the largest majority of cases the diagnosis as already stated is made at the time of the operation. There are several instances however, in which the diagnosis was made before the operation: namely, by Israel, Albrecht, and Richter. The first positive diagnosis of dystopic kidney that was made by the aid of the shadowgraph catheter was reported by Müllerhain in a woman with a pelvic kidney.

The presence of calculi in a dystopic kidney is not of frequent occurrence. Strater in his collection of 67 cases of dystopic kidneys from the literature records one case of Israel and one case of Abrajonoff. The above mentioned case, inasmuch as it is the first case (as far as I know), in which a positive diagnosis of stone in a dystopic kidney was made by this method and in which the diagnosis was confirmed by operation, may be looked upon as a rather unique case.

By the aid of this method Chalzoff made a diagnosis of a dystopic right kidney and absence of the left kidney. This diagnosis was confirmed by autopsy.

That this method can be used in making a differential diagnosis between floating kidney and a floating spleen is illustrated by the case of Illyes, whose patient presented this problem for diagnosis. The shadowgraph catheter was introduced and the X-ray picture showed the kidney and ureter to be in their normal position. This diagnosis was verified by laparotomy.

POST-OPERATIVE INTESTINAL OBSTRUCTION[1]

By GEORGE WOOLSEY, M. D., New York City, New York

WHETHER it occurs as a complication of convalescence or months or years after the abdominal section, there is no other condition that more imperatively demands early diagnosis and prompt relief. In the one instance it may occur when the anxiety of both the surgeon and patient alike has begun to relax with the establishment of convalescence; in the other, it often comes like a thunderbolt out of a clear sky when the operation and its cause are things of the past, and there is no thought of a lurking danger in the few remaining adhesions. In spite of the improvements in technique in intraperitoneal operations, this complication occurs not uncommonly, for, by very reason of the improved technique, the number of such operations has been vastly increased. In the case of septic or paralytic obstruction, however, modern technique has greatly reduced its relative frequency.

In the past five years there have been 50 cases, recorded as post-operative and post-inflammatory intestinal obstruction, treated at the Presbyterian Hospital, 60 per cent of which were complete and 40 per cent partial obstructions. Of these, only 6 have been instances of paralytic obstruction, while adhesions were noted in 19, bands in 12, and both bands and adhesions in 10, causing strangulation in 9 cases, volvulus in 2, and angulation or a valvular closure (ventilverschluss) in most of the other cases. Nine of these have been in my service (8 operations, mortality 12.5 per cent) and I have had an equal number during that time in private practice and in my service at Bellevue Hospital. The statement has been made by a writer (1) on this subject, six years ago, that the majority of cases occur within two weeks of the operation. This has not been my experience, and of the 50 cases above mentioned, 70 per cent occurred after the two weeks' period. Perhaps the improved technique in the operation and after treatment of cases of septic peritonitis has so diminished the number of cases of paralytic obstruction as to account for this great difference in percentage.

There are so many interesting questions involved in the etiology, diagnosis, prevention, and treatment that the subject is an absorbing one. It is one also that concerns all surgeons. As to classification we have already intimated that cases may occur early or late, according to Broca's division. The late cases are all of mechanical origin; the early cases may be mechanical or paralytic.

The cases of mechanical post-operative obstruction may be due to *strangulation*, when the circulation is interfered with from the pressure of a band or from a volvulus, or both, or to an *obturation*, due most often to an angulation by the kinking of the gut and the formation of a valve-like arrangement, preventing the contents of the distended proximal segment of the loop passing into its distal segment. In time in a mechanical obstruction the gut may become paralyzed, by reason of overdistension, so that the two forms may be associated in one case.

Paralytic obstruction is most often, but not invariably, due to sepsis. There are a few interesting cases of paralytic obstruction, which depend upon disturbances of the innervation or circulation of the bowel, the so-called adynamic obstruction. In a few cases also the temporary paralysis due to handling of the intestine seems to have been unduly prolonged so as to cause obstruction. The above classification is a convenient one in studying these cases.

Etiology. The two great etiological factors in post-operative obstruction are either of a septic or a mechanical nature. The etiology of mechanical obstruction is not difficult to understand, though the mechanism is varied. When due to strangulation, the cause is usually a band or a volvulus, or both. I have recently operated on an example of the latter type where a band, due to an operation thirteen years before, had so narrowed the mesentery

[1] Read before the American Surgical Association, Washington, May 2, 1910.

at the base of a loop of ilium, as to render volvulus an easy matter. In addition, the band, itself, tightened by the twist of the volvulus, strangulated the mesentery and compressed one end of the loop. Resection of fourteen inches was done and recovery was uneventful. In strangulation there is usually an obturation, at one or both ends of the loop, from the band or volvulus, but the important factor is the stasis of the blood supply. Thrombosis occurs in time, and may subsequently extend. Whether the nerves that accompany the vessels are paralyzed by pressure or not is of little moment, for the mesenteric or Auerbach's plexus is capable of carrying on peristalsis independently. When, however, the blood supply is entirely cut off from this plexus, paralysis of the gut soon follows in the same way as it does in cases of thrombosis of the mesenteric vessels. Hence, in strangulation we eventually have a combination of mechanical and paralytic obstruction. The importance of early diagnosis and relief is evident in order to prevent or anticipate the occurrence of paralysis and gangrene of the loop of gut. Fortunately, the onset of strangulation is often gradual and not complete at once, so that by early operation we are able to relieve the condition without intestinal resection. The band causing the strangulation I have found due to an adherent omentum, an adherent loop of intestine, or, more commonly, an old adhesion.

Obturation. A band of adhesions may also cause a simple obturation, without strangulation, if it compresses the bowel transversely to its long axis, and thus does not cut off its circulation.

The commonest form of mechanical obstruction depends upon a kinking or angulation of a loop of gut due to its adhesion to the parietes or another loop. This I have found most often in or just above the pelvis and the small intestine is the part involved, as it is also in the vast majority of all cases of post-operative obstruction (95 per cent, Gibson). Intestinal adhesions are exceedingly common for they follow almost all abdominal operations and most peritoneal inflammations to a greater or less extent. In the past sixteen months I have operated on two cases of obstruction, due to adhesions, with a history of an inflammation some time before, but no operation, and three others of the 50 cases collected at the Presbyterian Hospital during the last five years were of this nature. We know that most of the peritoneal adhesions formed become stretched, attenuated, and disappear, largely under the influence of repeated peristalsis. Some that are firmer than others and those existing where the source of infection is still present, may remain, or, if in the latter category, may increase. But we know from our experience in operating on many cases presenting peritoneal adhesions, that by far the greater number of these do not give rise to obstruction. Post-operative obstruction often follows the cases in which we little expect it and not the worst cases. In acute suppurative appendicitis, and in peritonitis from other causes, many intestinal loops adhere, and are held together in a normal and not in an abnormal position, as after some operations where the intestines are much handled. Otherwise, obstruction would be more common after unoperated appendicitis than it is.

The factor that seems to determine the obstruction is the adhesion of a loop of gut in an abnormal position. Hence, also the disadvantage of opening an acute appendicitis requiring drainage to the inner side of the cæcum where the drainage tract may result in adhesions of the small intestine to the cæcum. Hawkes (2) has found such adhesions to be the cause of the obstruction in several cases. In operating for obstruction I have often found a loop of small intestine angulated by adhesions to the bottom of the pelvis, where it did not normally belong. The method of floating the intestines into place by pouring in hot normal saline solution at the end of the operation, is therefore a rational one.

Another factor to be considered in the matter of adhesions is a personal idiosyncrasy to the formation of firm adhesions, and often of many such. In most cases of mechanical obstruction a few firm adhesions, or only a single one, are found, and the greater part of the peritoneal cavity is free from them. I have observed this idiosyncrasy to adhesion formation in three or four cases, and it has been referred to by others. Thus, Lillienthal thinks that such idiosyncrasy is more common among women. About three

and a half years ago I operated on a young woman of nineteen (No. 3385 Presbyterian Hospital) for partial obstruction. This was the fifth operation for obstruction since an operation for appendicitis two years before. Here, in spite of the removal of the appendix there were many adhesions causing the angulation of two or three loops of small intestine without producing complete obstruction. The attempt was made by the use of the Cargile membrane and omental grafts to prevent the adhesions re-forming, but I heard of her a few months later as being again in a similar condition, and suggested the use of thiosinamin or fibrolysin. I have also seen two young men who had been operated several times for obstruction after appendectomy. They both presented symptoms of obstruction, with very great distension, but refused further operation. One was partly relieved by repeated enemata. Brewer has also reported a case in which there had been eleven laparotomies, six of which were for obstruction.

The usual mechanism of the obstruction occasioned by kinking or angulation, whether due to adhesions or to great distension, is after the manner of a trap (ventilverschluss). Thus, the gas or fluid contents in the proximal or oval arm of the loop presses the distended outer end of this arm against that of the distal arm and closes it, as the ureter is closed in a case of high implantation of the pelvis, by the pressure of the fluid in the latter. The adhesion draws out the two arms of the loop so that they are parallel and in contact, so that distension in one tends to close the other, and it prevents the bend of the loop from being straightened out by the peristaltic action. Fischer(3) reports three autopsies for post-operative obstruction, in which the bowel was included in the deep tension sutures of wire, by the peristaltic action, and occluded. These were operated by three well-known surgeons, and he has known of other cases where the bowel was impaled by the suture. Fortunately, such cases are not common.

In many early cases, due to angulation from adhesions, the obstruction is probably not complete until an attack of indigestion or an indiscretion in diet causes an increase in the amount of gas in the proximal arm of an adherent loop.

Another cause of early post-operative obstruction, in cases with an extensive peritonitis, is secondary abscess. These are not infrequently reported, and almost without exception the obstruction is attributed to the adhesions of the intestinal coils forming the walls of the abscess or possibly to a local septic paralysis. I have operated on several of these within the past few years, and without exception the obstruction has been relieved at once by the evacuation of the pus. My own explanation after studying these cases, is that the obstruction is due to the pressure of the abscess. The adhesions are a contributing cause, for they prevent the loops of gut from escaping from the pressure of the abscess which occludes the gut in a valve-like way (ventilverschluss) the abscess taking the place of the collection of gas or intestinal contents in the ordinary mechanical obstruction from adhesions. Or again, an adherent loop may be compressed between the abscess and some firm structure, like the abdominal wall.

Another etiological factor sometimes reported as a cause of post-operative obstruction is the Trendelenburg position. In two or three cases that I have observed this has seemed to be the cause or a contributing cause of obstruction. Kraske has reported two cases following suprapubic operations, but most have followed laparotomies. It has seemed to me that the intestines, by reason of an abnormal position in which they are left or by the pressure of the rolled-up omentum, can not readily expel the gas, and become more and more distended until the distension, by kinking them and rendering them paretic, continues and increases the trouble. Hence, the importance of letting the patient down and replacing the intestines and omentum in good position (as by floating them into position) before the wound is sutured.

In *paralytic* obstruction, the etiology is not always the same. A nearly similar result may be brought about by a septic peritonitis, handling of the intestines during operation, and direct or indirect disturbance of its nerve supply in extraperitoneal operations, or injuries. Of course, septic peritonitis is the most common factor, but exactly why or how it causes the paralysis is not definitely known. It may be due to reflex action, vaso-motor

disturbances or the direct effect of the toxins on the intestinal nerves or musculature. In the last analysis it must be through some action on the intestinal plexus or muscle fibres. We know that peristalsis is a co-ordinated movement, having its local reflex center in Auerbach's plexus, and that it can go on for a considerable time while the plexus is entirely disconnected from the central nervous system.

Cannon and Murphy have demonstrated that peristalsis may be reflexly inhibited through the splanchnic nerves. In a case of Kocher's the obstruction was due to reflex intestinal paralysis, due to strangulation of the omentum. I have observed a similar condition in a case of torsion of the omentum. A remote inflammatory focus, as in the pleura, may have a similar result, and I have known of it in pneumonia. In all these cases the intestinal paralysis is of reflex origin, and this is probably a common cause.

Another explanation accounts for the production of some cases. The handling of the intestine at the operation is followed by its paralysis for a few hours,— up to twenty-four or more. If it is unusually prolonged the paralyzed gut may become overdistended by the gases developed from the intestinal contents. Many, if not most of the mild cases of post-operative intestinal paralysis, are due to such a mechanical injury, while most of the severe cases depend upon sepsis.

Overdistension may lead to paralysis of the bowel as of the bladder and the paralysis is thus continued. Overdistension may also cause obstruction by kinking the intestine, and if the latter is so paretic that it cannot overcome the angulation, obstruction occurs from the same valve-like mechanism as when due to adhesions. Possibly paralytic obstruction may also be due to traction on the nerves of the mesentery in opposite directions by distended coils lying on opposite sides. Distension may also lead to volvulus. This same overdistension may occur with mechanical obstruction, and thus add a paralytic to a mechanical condition as a cause of the obstruction.

Israel (4) has reported two cases of isolated drum-like distension of the cæcum following an extraperitoneal kidney operation. Here, either the intestinal plexus was directly damaged or reflexly inhibited through the nerves connecting it with the abdominal ganglia. It is also well known that a blow on the abdomen may cause a paralysis of the peristalsis for some time, and the same cause has also resulted (5) in a ring-like stricture from an injury of the bowel wall.

It has been held that the overaction of the bowels, as seen in mechanical obstruction, results in their paralysis. This is denied by v. Stockum (6) who says that continued increased peristalsis does not lead to intestinal paralysis but to hypertrophy, a paresis never results. This is illustrated in the obstruction due to intestinal carcinoma.

The terms dynamic and adynamic obstruction are often used interchangeably and thus lead to confusion. Strictly adynamic obstruction is the paralytic form and dynamic is the rare form, due to a spasmodic contraction of a segment of gut, which has been shown experimentally to be of possible though rare occurrence. Little is known of it clinically, and we will not consider it further. In Mikulicz's very satisfactory classification into mechanical and dynamic obstruction, the latter includes all forms that are not of mechanical origin. To avoid confusion, it seems better to call the dynamic forms paralytic obstruction.

Sixteen years ago nearly all reported cases followed gynecological operations; to-day the majority follow operations on the appendix. This is natural, in view of the great numbers of such operations and the presence of the inflammation which of itself would give rise to adhesions. There can be no doubt that the extent and character of the adhesions, and the occurrence of early obstruction, are much influenced by the amount and character of the drainage, the technique of the operation itself, and the post-operative treatment. In only one of the 50 collected cases was the appendectomy an interval operation, five years before, though many such cases are reported. Pelvic operations form the second commonest cause, and of these, singularly enough, ovarian cysts are followed by obstruction relatively more often, than pyosalpinx, in which the conditions would appear more favorable. In the 50 cases I collected at the Presbyterian Hospital, 32 followed appendicitis, of which 3 had not been

operated, 13 pelvic conditions (5 ovarian cysts), 2 those of the stomach, and 1 a gall-bladder operation. In one case following an operation on the stomach a small segment of ileum was so twisted in its longitudinal axis as to cause obstruction. The patient had taken the anæsthetic badly and loops of small intestine had to be replaced within the abdomen, at the lower end of the incision, repeatedly during the operation. Such a mechanism of obstruction must be most uncommon.

Among those 50 cases, 33 were females and 17 males. The age varied from six months to seventy-three years, averaging 27.4 years. The average age of cases of complete obstruction (22.3 years) was very noticeably lower than that of the cases of partial obstruction (35.3 years). The average duration of acute symptoms in 26 of the cases of acute obstruction, in which this detail is given, was three days and rather less in the 9 fatal cases than in the 17 cured cases. In the cases following appendicitis the time between the first operation and that for the obstruction varied from six days to sixteen years, and averaged a little over two years; in the pelvic cases it varied from two days to sixteen years, and averaged over two and a half years. The total mortality of the 48 operations was 37.2 per cent, that of the partial obstructions, 35 per cent, as compared with 38.7 per cent in complete obstructions.

As to the pathology of the fatal result in cases where the condition is not relieved or relieved too late, we can readily understand the cause in septic or paralytic cases with peritonitis, and in cases of strangulation where the bowel becomes gangrenous, leading to peritonitis. Roger, of Paris, MacCullum, and others have found bacteria circulating in the blood in great numbers in such cases of obstruction in the ileum and colon.

In cases of mechanical obstruction without strangulation, the problem is more complicated. Absorption of one thing or another from the bowel contents has been generally credited as the important factor, but this is now disputed. Experimentally it has been found (7) in rabbits that there is no bacteremia in fatal mechanical obstruction when there are no bacteria in the peritoneal cavity, i. e., when there is no peritonitis. In such cases death was attributed to autointoxication from the decomposed intestinal contents. Thus, Nesbitt (8) found in the afferent loop of complete obstructions of the lower ileum the constant presence of neurin if food containing much lecithin had been ingested. Others (9) have isolated putrescin in a strangulated loop. The absorption of these and other very active poisons would account for the restlessness and great prostration in these cases, and explains the benefit of washing out the stomach or emptying the efferent loop. Treves has stated that the establishment of an opening in the bowel above an obstruction which has been found and relieved has reduced the mortality by fifty per cent.

But Braun(10) claims that this autointoxication is not the cause, and attributes the terminal sinking of blood pressure to an anæmic or asphyxiated paralysis of the basal brain centers due to the great stasis of blood which one finds in the abdominal viscera,— a bleeding, as it were, into the splanchnic region. This, he says, depends upon the irritation of the intestinal obstruction, and is increased by the exaggerated intestinal and glandular activity. He seems to be led to this view by the resemblance of the pulse and respiration curves to those in death from hæmorrhage. The injection of animals with the poisonous intestinal contents gave results in no wise resembling ileus in its symptoms or the pulse and respiration curves. According to this view, the drainage of the bowel above the obstruction by an enterostomy works favorably, not by the removal of the poisonous intestinal contents, but by decreasing the circulation in the abdomen. F. T. Murphy's experiments have led to a somewhat similar conclusion, namely, that the collapse so often observed in severe cases is largely due to a vasomotor paralysis, in the production of which the obstruction of the venous flow seems to be the essential factor. These views as to the pathology of the fatal effect of obstruction are in some measure confirmed by Maury's (11) experiments on the cause of death in obstruction of the bowels within the first or oral 35 cm. from the pylorus. He found that the animals died just the same when the possibility of absorption of decomposed food was eliminated by previous fasting and

through purgation. He attributes the animals' death to absorption of toxins in the duodenal secretions, but as these toxins are neutralized by intestinal antitoxins if the obstruction is placed more than 35 cm. from the pylorus, this explanation applies only to cases of arteriomesenteric obstruction, and not to the cases of obstruction most commonly observed clinically. In all the several explanations the drainage for passage of the contents retained above the obstruction is of the greatest service therapeutically.

Diagnosis. The diagnosis of mechanical obstruction occurring late, weeks, months, or years after the operation, is not usually difficult. There is pain coming on suddenly, with colicky exacerbations, more or less localized to the region of the obstruction, but often referred to the epigastrium; nausea with vomiting at once or after an interval varying with the distance of the obstruction from the stomach; no passage of fæces or flatus, or none after one or two passages emptying the bowel below the obstruction; increased peristalsis and in time increasing distension, often asymmetrical. There is usually tenderness, often localized, in the region of the obstruction. The temperature is not elevated at first, and may be subnormal and the pulse may be somewhat rapid or nearly normal. The leucocyte count and indicanuria are both increased, but are of little value, as they are increased in so many other conditions. The diagnosis is evident without these aids.

Can we distinguish between strangulation and obturation? In many cases, yes, but not always. The so-called "peritoneal shock" is an early sign of strangulation. In this condition the pulse is rapid, the surface pale and cold, the temperature subnormal, and the face is anxious. I have found the pain in strangulation much more intense and persistent and the exacerbations more frequent than in obturation. But in practice, the differentiation is often very hard, especially as they may be combined even from the outset. Only in the subacute cases or those of partial obstruction, can there be any question between obstruction and a colic from other causes. The lack of a history of the ingestion of indigestible food or of a sudden chilling of the body, of a diarrhœa, of a lead line on the gums or of an occupation to warrant lead poisoning, of a history or signs of tabes, etc., enables us to make a correct diagnosis. In all these cases the history and scar of a previous abdominal operation are suggestive of the cause. A good rule to go by, if in doubt, is to perform laparotomy at once, if a moderate dose of morphine has to be repeated to control the pain.

Can we locate the situation of the obstruction? It is very desirable to do so, both with reference to the part of the intestine, and to its position in the abdomen. The abdominal scar helps us, but often not very precisely, for the obstruction may be at a considerable distance. The position of the initial pain, of the tenderness, and of the first appearance of distension, assist in determining the position of the obstruction. In thin subjects the exaggerated peristalsis can sometimes be seen, in stouter subjects be heard, to end at a definite point, but we can not localize it quite so well by auscultation. The early or late onset and the frequency of the vomiting, and the character of the vomitus, help us in judging whether the obstruction is high or low in the bowel. Occasionally the distended loop of a strangulation or volvulus has been made out by inspection by reason of the asymmetry of the abdomen or by palpation by reason of its increased resistance (von Wahl's sign). But when all is said the diagnosis of the position of the obstruction is uncertain, and I have been mistaken when I felt quite sure of the site of the obstruction. In post-operative obstruction we know that the site of the obstruction is in the small intestine in, at least, 85 per cent (Gibson), so that it is largely a question of high or low in the small gut. I have found the adhesions most often in the pelvis, even in cases following appendicitis. Hawkes mentions finding them most often at the inner side of the caput coli.

In *early cases*, those occurring in the first ten to fourteen days after operation, the diagnosis is not so simple, but is often obscured by conditions which necessitated or were present at the time of the previous operation, i. e., infection, trauma, sequelæ of anæsthesia, etc. If there was no peritonitis at the time of operation and no signs of any since, obstructive symptoms indicate mechanical obstruction

except in the first day or two, when they may depend upon a post-operative intestinal atony.

In cases where peritonitis was present on operating, the conditions are more complex. We must here diagnose between spreading peritonitis and obstruction. Peritonitis itself, especially if it is spreading, gives many of the symptoms indicative of obstruction, pain, nausea, vomiting, etc., and the symptoms of the two conditions are so nearly identical that the diagnosis is often difficult and at times impossible.

In obstruction the pulse is quiet, full, and regular until the patient becomes toxic, the pain is more paroxysmal, the vomiting may be of larger amounts and less frequent, and there is little if any rise in temperature at first. If the initial rise of temperature of the peritonitis has approached the normal after operation, a further rise of temperature at the onset of the obstructive symptoms indicates a peritonitic cause, i. e., a spreading peritonitis or a localized secondary abscess. The leucocyte count, differential as well as general, is of doubtful value, but a low count helps to exclude inflammation and it is not as likely to rise or be as high in obstruction as in peritonitis. According to Javel (12) facies abdominalis, as an early symptom, speaks for peritonitis or strangulation and one of the earliest signs of peritonitis are hyperæmic spots on the forehead. Frequent micturition suggests a local peritonitis, and restlessness and excitement indicate peritonitis, though, in my experience, they are quite as characteristic of obstruction. Javel also affirms that a general peritonitis can progress with a normal frequency of pulse. Rigidity is a most important sign of peritonitis, but may be wanting when the patient becomes very toxic. Furthermore, in most of the class of cases under consideration, obstruction, if present, coexists with peritonitis, so that the diagnostic requirement is to distinguish between peritonitis alone and peritonitis plus obstruction. Constipation is the main thing. This, or the reverse, may be present in peritonitis, but gas or fæces are likely to be passed after enemata; not so in an obstruction which does not yield. If repeated enemata of various kinds, and perhaps the moderate use of cathartics, are not followed by the passage of gas or fæces, and especially if other signs of obstruction are also present, such as colicky pain, vomiting, distension, etc., we should diagnose and treat the case as one of obstruction for the safety of the patient.

Again the question arises after diagnosing an early post-operative obstruction, where peritonitis is or has been present, can we distinguish between the mechanical and the paralytic forms? This is very essential as the former is very amenable to operative treatment, the latter much less so. It is often difficult and in many cases impossible to differentiate between them. The sudden onset of pain is indicative of volvulus or strangulation. The pain is more severe and persistent in mechanical obstruction than in the paralytic form. Corresponding to this we find that the peristalsis is much increased in mechanical and diminished in paralytic obstruction. In mechanical obstruction the patients may assume peculiar positions to relax the abdomen and its viscera, while in paralytic obstruction they lie more quietly on the back with the knees drawn up. Vomiting comes on later in mechanical obstruction, unless it is in the upper bowel, and in the paralytic form there are more frequent regurgitations of a dark fluid from the stomach. Distension too, may be more marked, and more uniform in paralytic obstruction. After all is said, it may be impossible in the individual case to diagnose the mechanical from the paralytic form and we must be guided by this fact in the treatment.

In all cases of post-operative obstruction, the possibility of an acute dilatation of the stomach or arterio-mesenteric ileus, should not be forgotten. In my experience, this is of more common occurrence than generally recognized. It may come on with a sudden or a more gradual onset in the first few days after operation. There may be acute or diffuse abdominal pain in the early stages. Vomiting of large quantities of yellowish or greenish, sour-smelling fluid at frequent intervals, with little or no effort, distension of the upper abdomen, rapid pulse and respiration, and normal or subnormal temperature, great restlessness, an anxious expression, great prostration, intense thirst, scanty urine, and constipation, are the principal symptoms. The constipation

is not absolute, flatus is often passed after enemata, and occasionally watery stools have been observed. There is usually succussion over the stomach. There is little or no tenderness, rigidity, or leucocytosis. The use of the stomach tube will confirm the diagnosis. It would seem that the diagnosis would be easy, but experience in the past has proved otherwise. However, if one has once seen the condition and has it in mind, I do not think the diagnosis is difficult. The causative effect of prolonged narcosis has been mentioned by several writers, and in the first case in my experience in which the condition was recognized, the patient had been under the influence of chloroform for two days before operation on account of intense pain, not relieved by morphine. This case yielded to treatment. Finally, it must not be forgotten that exceptional cases of post-operative obstruction are lacking in some or several of the characteristic symptoms of that condition. Thus, Rogers reports a case where there was gangrene under a band in the jejunum without any pain, rigidity, or distension.

Treatment. This resolves itself into prophylaxis and treatment proper, of which the former is fully as important as and often more successful than the latter.

Prophylaxis. Can we avoid post-operative obstruction or lessen the frequency of its occurrence? Practically all cases are due to sepsis, operative trauma, or adhesions. The problem, then, is to prevent or lessen the frequency of the occurrence of these three factors. If the rule of operating for appendicitis in practically all cases as soon as the diagnosis can be made were generally followed, most cases of septic or paralytic obstruction would be avoided. In the presence of septic peritonitis a rapid operation, avoidance of trauma to the peritoneum, the use of the continuous drip enema and the Fowler position, the avoidance of food or catharsis by the mouth, and the employment of milk and molasses and similar enemata to relieve distension, will cure most cases of spreading peritonitis and prevent the occurrence of paralytic obstruction. An intravenous saline infusion helps in the elimination of the toxins, and is an excellent stimulant, thus serving a double purpose.

After evacuating some of the pus of a septic peritonitis at the operation, the introduction of sheep serum or, better still, the concentrated antiferment serum (ascitic fluid, etc.) may be effective in checking the peritonitis and preventing septic ileus.

A nearly opposite plan is employed and advocated by some. Thus, Heile thinks early bowel movement gives the best result and tries to excite peristalsis directly after the operation so as to distribute the germs, increase the hyperæmia of the peritoneum and the autolysis and resorption of the pus. To this end he injects 50 to 100 cc. of warm castor oil into the intestine during the operation, and the next day he employs enemata, physostigmine, etc., energetically, until a good result is obtained. He also uses a saline infusion, and claims that his mortality has been much lowered by the use of this method. Along the same lines, McCosh formerly employed and advocated an injection of mag. sulphate into the bowels during operation, and I have used it in a few cases. As these cases were among the worst of their kind, it is difficult to estimate the value of the method.

Several report the use of eserine (physostigmine) salicylate, given prophylactically, before and immediately after operation, and claim good results. Among German surgeons atropine has been similarly used quite a good deal, but many condemn it. I confess that I like to see the bowels move early under certain circumstances in septic peritonitis, i. e., when distension is marked and increasing. Not only is meteorismus an indication at times of intestinal paralysis, but it may of itself cause it. When distension is marked and increasing, I employ lavage and give an enema of milk and molasses, p. e., or one containing ox gall, spts. turpentine, and emulsion of asafœtida, or sometimes one containing alum, repeating these if needed. Hot stupes to the abdomen are also useful. Often great quantities of gas are passed, perhaps there is a good fæcal result as well, and the condition is relieved. But if the distension quickly recurs, or is not relieved at first, I have several times used one-sixtieth to one-thirtieth grain physostigmine salicylate hypodermically, repeating it q. 2 h. for two or three doses, and the result has not infrequently

been very satisfactory. I have never seen any bad results, and have never used it as a routine treatment. Too great faith in physostigmine or atropine interferes with careful diagnosis, and postpones more effective treatment.

It is in cases of post-operative intestinal atony that this treatment with physostigmine is most clearly indicated. This atony is largely due to the handling of the intestines and is normally temporary, but I have several times seen it lead to great distension which increases the paralysis, and leads also to angulation.

It is in the early period of distension that the use of physostigmine, combined with enemata and lavage as above described, works like a charm, and the entire aspect of the case is changed in a very short time. There may or may not have been peritonitis of moderate extent present when the case was operated, and the appearance on the second day p. o. is that of obstruction or a condition very close to it, with distension, vomiting, pain, restlessness, and no passage of flatus or fæces. The result of the above treatment in such cases is often most satisfactory.

As it has been shown by Cannon and Murphy that this local post-operative paralysis is largely due to handling,—even the gentlest handling, of the intestines, and that its duration is in proportion to the amount and roughness of the handling, it follows that there should be as little and as gentle handling of the bowels during operation as possible. These experimenters showed that unusual cooling or exposure to the air of the bowels, under aseptic precautions, and a long etherization of the animal, produced no appreciable paretic effect on the bowels.

Since employing the above plans of treatment I seldom see clearly post-operative obstruction due to septic or post-operative paralysis.

I agree with Peck (13) that careful post-operative treatment is of the greatest importance in the prophylaxis of obstruction. Not infrequently, an attack of indigestion and the formation of gas distending the bowel already adherent, perhaps paretic, and partially obstructed, will induce an attack of obstruction which might have been averted if the patient had been carefully watched, warmed, and dieted in the first few weeks of convalescence.

Adhesions are a most prolific source of obstruction. What can we do to prevent them? As they are likely to form in an attack of acute appendicitis and are more widespread the more diffuse the peritonitis, we should advise operation as soon as the diagnosis is made or, at least, in the first interval, and not wait for several attacks. I have recently operated on two patients with obstruction due to adhesions from appendicitis not operated upon. For the same reasons other intraperitoneal inflammations should be operated upon without undue delay.

The technique of the operation affects very materially the formation of adhesions. Rough handling and mechanical irritation, drying by exposure to the air, contact with chemical irritants (antiseptics), and the introduction of foreign bodies (drains), promote the formation of adhesions, and should be avoided as much as possible by careful attention to the technique. We no longer use antiseptics on the peritoneum. As Baisch's experiments lead to the conclusion that adhesions depend upon blood in the peritoneal cavity, careful hemostasis is very desirable.

A fruitful source of adhesions is drainage. The use of drains is avoided altogether if we operate early enough. No gauze drains should be used unless covered by rubber tissue or tubing. Dr. F. T. Murphy has demonstrated that gauze drains are walled off by adhesions more rapidly than glass or rubber tubing or rubber-tissue wicks, and that a cigarette drain does not drain the general peritoneal cavity after eighteen hours. Hence, drains should be avoided if possible, they should not be left in long, and they should be of a non-irritating substance, rubber tissue or tubing unless the object is to wall off a local septic process. Moreover, the position of the drains is a matter of primary importance. As far as possible they should be bounded on one side by parietal and on the other side by visceral peritoneum and not on all sides by the latter, to diminish the chances of obstructive adhesions. Hence, if in a case of appendicitis with peritonitis, it is necessary to drain the pelvis, the drain should pass down outside the caput coli, between it and the iliac fossa, and not to its inner side among the intestinal coils where the adhesions

will bind these coils together and to the cæcum. In the pelvis a barrier of omentum may be used to protect the intestinal coils. The removal of a drain internal to the cæcum is also more apt to twist or displace the contiguous coils. Hence, for drainage the muscle splitting incision is better than the Kammerer.

As absorption of adhesions occurs earlier and more evenly if the focus of infection is removed, the appendix should always be removed if possible. I cannot agree with the statement made that mechanical obstruction is more often due to appendicitis not operated upon than to appendicitis operated upon, because the focus is not removed in the former case. For obstruction is not so much due to the number or firmness of the adhesions, as to adhesions which hold the bowel in an abnormal position. For this reason, we should avoid as far as possible, the displacement of the intestines during operations or, at least, we should try to replace them by floating them into position or otherwise, and prevent their adhesion to the wound and to raw surfaces by interposing omentum.

As areas denuded of peritoneum invite adhesions of the firmest kind, they should be covered by peritoneal suture, omental graft, etc., as far as possible. As after any intraperitoneal operation, especially if there is much handling or exposure of the bowels, adhesions are liable to form, many have attempted to solve the problem of preventing or minimizing these adhesions, but with only partial success. The prevention of post-operative adhesions is mainly a matter of general technique and not of any one procedure or remedial agent. Rigid asepsis; prevention of cooling or drying of the exposed parts by the use of hot salt solution, by keeping them covered, and by rapid operating; avoidance of undue handling, by proper position, etc., and of unnecessary packs and pads; avoidance of raw surfaces by covering them with peritoneum or omental grafts; early establishment of peristalsis and catharsis by enemata, physostigmine, etc.(13); frequent change of position after operation; these and perhaps other similar measures may, under ideal conditions, assist in avoiding adhesions, save perhaps the very finest, and they are soon dissipated by peristalsis. But most operations do not offer such ideal conditions, or the problem may be to prevent the re-formation of adhesions that have had to be broken up during the operation.

Can we prevent the re-formation of existing adhesions? Not with our present knowledge. The best we can do is to minimize them. This problem has been approached experimentally, and various methods tried on animals and then on the human subject. The variety of methods used and of substances interposed between raw surfaces to prevent their adhesion by fibrin and later by fibrous tissue is very large, and we can only enumerate them. Normal salt solution floats the bowels well into place, but does not separate them,— they merely float on it. Cargile membrane, collodium, and a film of aristol fail. Charring by the cautery prevents, milder cauterization produces adhesions, but the former is not often applicable. Thiosinamine or fibrolysin to soften or dissolve adhesions; phosphorus by mouth, and peptone hypodermically to prevent the formation of fibrin and thereby the agglutination of opposed serous surfaces; non-irritating fats and mucoid substances, such as olive oil, paraffin, tallow, lanolin, agar, and gelatin and mucilage, to form an even thin coating on the serous surfaces, have all been tried and some have found enthusiastic supporters. But unbiased opinion is to the effect that no one is a panacea, though some have a certain value. Blake, of Boston, in a paper before this association, reported experiments in the use of sterile olive oil and concluded that it was harmless in moderate quantity, and that the adhesions were fewer and less dense. Heohne (14) recommends Glimm's method of injecting 30 cc. of sterile 10 per cent camphorated oil into the peritoneal cavity to prevent peritonitis and incidentally adhesions. Gellhorn(15)speaks encouragingly of lanolin,but the best results have apparently been obtained by the use of a thick mucilage of gum arabic. In cases where adhesions have formed, especially where there seems to be an idiosyncrasy to the formation of firm adhesions, I would advise the trial of thiosinamine or fibrolysin.

The treatment of actual obstruction is operative.

Late obstructions. The chances of palliation

are slim and many of the adhesions have disappeared so that the operation is easier. If we can diagnose the variety and position of the obstruction, the operation is much simplified. The incision is made over the site of the obstruction. Otherwise the laparotomy must be in the first place exploratory. In such cases the incision must be ample for exploration and is made to the median side of the scar or in the median line. The collapsed and distended portions of the intestine are the best guide to the site of the obstruction, which is almost always in the small intestine. In all cases the operation must be performed as soon as possible after the diagnosis is made, after a reasonable attempt has been made to move the bowels by repeated enemata of milk and molasses, or enemata containing glycerin or ox gall, asafœtida, and spirits of turpentine. Often cathartics have already been given, but of course these should never be persisted in.

After the site of the obstruction is found the cause must be relieved, adhesions or bands severed between two ligatures, a volvulus untwisted and its predisposing cause, bands or adhesions, narrowing the base of the loop relieved. If the viability of the intestine, in case of strangulation or volvulus, is questionable, the affected intestine should be covered with pads wet with hot saline solution. If the circulation returns in ten or fifteen minutes, and there is no line or area which appears necrotic, the incision may be closed; otherwise, immediate resection of the necrotic area and anastomosis, end to end or side to side, is preferable to an artificial anus, if the condition of the patient justifies it. In some cases if the vitality of the gut at the site of a constricting band is doubtful, omentum may be sutured over it. Obstructive adhesions have formed at the site of the appendix whether the stump is inverted or cauterized. When there is much matting together by adhesions with obstruction, Deaver recommends lateral anastomosis of the afferent and efferent loops, but I have not found the conditions present that would demand such a procedure.

The indications for treatment are not so clear in *early obstructions*. Most of them depend upon sepsis, but some are due to mechanical causes or to both causes combined. The later it occurs after operation the more likely is a mechanical element to be present. In early cases the onset of the trouble is masked by phenomena that we are wont to meet with after laparotomies, especially the vomiting and pain. If the vomiting is unusually prolonged, it is often attributed to increased sensibility of the stomach or to some idiosyncrasy. The surgeon hesitates and employs palliative treatment, he does not want to believe that the complication exists, and dislikes to propose a second operation, and thus he loses the opportune moment. The patient is very restless, with an anxious expression or, from the septic intoxication, becomes lethargic and complains of little but frequent vomiting or gulping of a brownish fluid. The abdomen is distended and the pulse and respiration are much affected by it. Peristalsis is very weak or wanting. The condition rapidly deteriorates and the chances of a successful operation are desperate.

In these cases we must begin early. Lavage should be done where the vomiting is frequently repeated, or is continued beyond the first twenty-four or thirty-six hours. In some cases with continued vomiting, especially where the distension begins in the epigastrium and is later most marked there, I have several times seen repeated lavage, together with turning the patient on the stomach (or knee-chest position), result in wonderful improvement and ultimate recovery. These are cases of acute dilatation of the stomach or arteriomesenteric ileus.

In all of the cases described above the stomach tube is of great service, and in addition, I use enemata, stupes, physostigmine, etc., as described above. Electricity applied through an electrode in the rectum has been successfully used, but I know nothing of it. If a little gas or gas and fæcal matter passes, this line of treatment is persisted in. If more gas, etc., passes and the distension begins to relax, the adynamic obstruction is often relieved.

If palliative treatment is not effective in the first few hours, operation should not be long delayed, and ileostomy or an exploratory operation must be done. If the trouble comes on some days after operation, if pain is a prominent symptom, and especially if it is paroxysmal or localized and if peristalsis is active, a mechan-

ical cause is to be suspected and laparotomy done, if the patient's condition justifies it. In one case four days after operation, I found a mass of omentum riddled with pus pockets, causing obstruction by its pressure, and its removal was followed by a speedy cure.

If, on the other hand, the symptoms are more those of a septic ileus, ileostomy is indicated. In the most desperate cases this may be done through the opened-up wound. These cases and those where the patient's condition only allows an ileostomy under local anæsthesia, almost always die, in my experience. We must not wait until so late. An earlier laparotomy allows a rapid exploration and perhaps the discovery of a mechanical cause or an overlooked secondary abscess. The latter condition must always be looked for, especially after the first few days. But one must avoid trying to do too much. A tube fastened in by a purse-string suture, inverting the surface of the bowel, is watertight. Through it we may employ repeated irrigation and syphonage of the bowels. This is more effective than simple enterostomy, for it thins the bowel contents and adds syphonage to abdominal pressure to empty the bowels, which are paretic and have little power to empty themselves.

The stomach should be washed out before operation to avoid the danger of aspiration pneumonia and of asphyxia from the vomitus. For the same purpose the operation may be done under local or spinal anæsthesia.

Elsberg(16) has presented the case of enterostomy strongly, claiming that only a small per cent of cases of obstruction are in a condition to justify radical operation, and that in the worst cases and in the large midway class, enterostomy is the best treatment. As to the objections (1) that the cause is unrelieved, he cites two cases to show that it may be relieved be enterostomy alone, and says that if found at once, it may often be safely relieved, but even where it can be relieved, it is often better to save life by enterostomy and relieve the cause later. The objection (2) that a fæcal fistula may remain and require a second operation does not hold in the technique given above. As to the objection (3) that the gut may be or become gangrenous, his statistics show that only 5 per cent of acute obstructions, besides intussusception and volvulus, present gangrene. Enterostomy may prevent threatened gangrene, while if gangrene is found the loop may be brought out of the wound. The danger of leaving gangrenous gut behind is less than that of prolonged manipulations. His results with enterostomy are much better than those I have seen, because the operations were done earlier and not so exclusively as a last resort. McWilliams in reporting statistically on the 1,400 cases of appendicitis operated on in the Presbyterian Hospital, in the last five years, found twelve enterostomies, with a mortality of 83 per cent. Enterostomy is mostly employed in the bad cases of paralytic obstruction. It is inadvisable in early and mild cases, but if enterostomy is done, it should be done earlier than I have seen it done, to get satisfactory results. Multiple enterostomy, with drainage at one or more openings, has proved valuable in the hands of some.

In septic or paralytic obstruction, more than in any other form, prophylaxis is far more important and successful than operative treatment at a later stage. In my experience the general recognition by the profession of the importance of early operation, the improvements in technique and careful prophylaxis, have rendered this most hopeless class of cases of post-operative obstruction very much less common than formerly.

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DEPARTMENT OF
NICHOLAS SENN FESTSCHRIFT

DOUBLE DISTAL LIGATION OF THE COMMON CAROTID AND SUBCLAVIAN ARTERIES AT ONE SEANCE FOR INNOMINATE ANEURYSM

Report of Two Cases

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IN the title I say ligation "at one seance," in preference to Barwell's term of "simultaneous double distal ligation." The ligations are not simultaneous and could not be, as the carotid is invariably tied first and the subclavian is tied afterwards, although almost at once afterwards.

Distal ligation for aneurysm was first suggested by Brasdor in the ninth decade of the eighteenth century (exact date unknown), and was first performed by Deschamps in 1799. Deschamps's patient suffered from an aneurysm high up on the femoral artery and death resulted from the operation.

In 1815 Hogden claimed that a distal ligature should be so placed that no branch intervenes between the ligature and the aneurysm. Wardrop endorsed this view in 1825, but later abandoned it, and in his "new operation" advocated the application of a distal ligature regardless of the existence of an intervening branch.

Wardrop's famous case (Mrs. Denmark) suffered from innominate aneurysm, although the surgeon believed wrongly that she had a low carotid aneurysm and that the right carotid was obliterated. He tied the third part of the right subclavian. She was very greatly benefited and lived for two years, but the aneurysm persisted (Ashhurst's International Encyclopædia of Surgery).

There is considerable confusion as to the meaning of the terms "Wardrop's operation" and "Brasdor's operation." Matas (Keen's Surgery, vol. v, page 256) says: "In the aneurysms of the innominate artery, if the ligature is applied to the subclavian alone, it is Brasdor's operation that is performed, if applied to both the subclavian and the carotid of the same side, it is Wardrop's operation." The terms are so used in this article.

For many years after Wardrop's report (1828) distal ligation for innominate aneurysm received scant consideration from surgeons, but in 1865

renewed attention was called to it by Mr. Heath, who reported a case of ligation of the right carotid and subclavian. Heath's patient, though an habitual drunkard, lived four years.

In 1877 Barwell operated on his case. He performed Wardrop's operation and cured the aneurysm. The patient died six months later of bronchitis due to exposure (Ashhurst's International Encyclopædia of Surgery).

During the last thirty years the operation has been the subject of occasional discussion and of late years has received considerable attention. All such operations should be reported in order that enlarged statistics may enable us to clarify our ideas and reach positive conclusions.

Certain it is that if distal ligation is of use in any region it should be of value in an innominate aneurysm.

CASE 1. On the 4th of November, 1901, I reported to the Philadelphia Academy of Surgery the record of a patient upon whom I had tied the third part of the right subclavian artery and the first part of the primitive carotid artery for aneurysm of the innominate involving the primitive carotid. The operations were performed at one seance.

The man came from Indiana and had been referred to me by Dr. A. H. Spears, now of Neopit, Wisconsin. The patient was forty-five years of age and a blacksmith by occupation. He had contracted syphilis at the age of twenty. He came to the Jefferson Hospital December 4, 1899. There was a distinct bulging of the first and second costal cartilages, "great pulsation, marked bruit, and distinct thrill." On December 13th operation was performed. First the carotid was tied distal to the carotid aneurysm, then the third part of the subclavian was ligated. The right radial pulse could be detected the third day after the operation.

Five weeks after the operation the man was discharged from the hospital immensely benefited. It was very difficult to detect the aneurysm at all, the bulging of the chest had passed away, there was a slight murmur, and the thrill was scarcely perceptible. The pulsation of the origin of the carotid could be detected, but felt far away. The man returned to his home and, in spite of advice to the contrary, to his occupation. He even shod horses. He remained apparently well for many months, but twenty-two months after the operation he returned to the hospital seeking assistance. There was no apparent return of the old aneurysm, but he had developed a new aneurysm on the common carotid at the point of ligation, and the left carotid was dilated and beat very forcibly. We were unable to suggest any operation for his relief and he went home. Dr. Spears tells me that he lived about three years after the operation. The cause of his death is unknown.

This man was certainly greatly benefited by the operation; there was no cerebral complication from the carotid ligation, there was no circulatory disturbance in the right limb, and had he not returned to an occupation necessitating great muscular effort, the benefit would in all probability have been greater and the improvement would have been more lasting; in fact the new aneurysm might never have formed.

CASE 2. In July, 1907, Dr. Henry D. Moore of Philadelphia referred to me Miss E—. L—, 63 years of age. She was admitted to the Jefferson Hospital July 3d, 1907. She is white, is a single woman, and did housework.

The family history shows no record of aneurysm although one brother died of "paralysis," and one of "heart disease."

When a child she had whooping cough, measles, and scarlet fever. She has never had acute rheumatism, although now and then one or more joints ache, but even when painful the joints never swell. She has had no sickness since childhood. In June, 1906, she fell and bruised the right shoulder severely. About two weeks subsequent to the fall she noticed

a "beating swelling" above the inner end of the right clavicle. The beating became more distinct month by month.

Examination on admission:

A slender, fairly strong woman, exhibiting the evidences of arteriosclerosis. The radials are hard and tortuous and the temporals are tortuous. The lungs are normal. There is a slight friction sound in the 4th interspace of the left side about two inches to the left of the margin of the sternum. The kidneys are sound. The pupils are normal in size, equal, and react normally to light and accommodation. Above the inner end of the right clavicle and back of the sternocleido mastoid muscle there is a pulsating mass. The pulsation is expansile; there is a systolic thrill and a systolic bruit. The bruit is transmitted along the right carotid, but not the left carotid, and apparently not along either subclavian. There is no evidence of disease of the cardiac valves. The heart sounds are weak and indistinct on the left side, but somewhat louder on the right side. The pulse is synchronous and similar in character in the right and left radial arteries. Pulsation is not quite synchronous in the right and left carotid arteries.

There is no pain, no dyspnœa, no dysphagia, no voice change, and no venous congestion of the face or neck. The fluoroscope was not used and an X-ray picture was uncertain.

A diagnosis was made of aneurysm of or near the origin of the right common carotid and it was decided that the innominate should be ligated.

The operation was performed July 6th. The patient was anæsthetized.

In order to expose the innominate the inner end of the clavicle and the sternoclavicular joint were resected, and a portion of the sternum was bitten away by means of the rongeur. I followed Burrell's plan and removed the right half of the suprasternal notch and almost an inch on the right side of the bone below it. The pleura was easily pushed aside and the bifurcation of the innominate was thoroughly exposed about half an inch below the level of the sternoclavicular joint. The right inferior thyroid vein crossed the vessel distinctly below the bifurcation and the left innominate vein could be identified lower down. The innominate artery could have been tied with the utmost ease and operative safety. But alas for surgical ambitions — it was seen that the aneurysm was not carotid but was innominate. The innominate was the seat of a fusiform aneurysm, the bulge involving the entire vessel and being more marked on the left side of the artery than to the right or in front.

First, the common carotid was tied, distal to its origin, with two pieces of number two chromic catgut. The first part of the subclavian was then tied in the same manner. After the tightening of the ligatures the fusiform innominate distended and the pulsation became more marked.

The muscles were sutured with catgut, the skin wound was closed with silkworm gut, and a bit of rubber tissue was inserted as a drain. The wound was dressed. The entire right upper extermity was wrapped in cotton, was placed upon a pillow, and surrounded with warm water bags. The drains were removed in twenty-four hours.

The radial pulse was perceptible on the fifth day, at which time the cotton was removed from the limb. Primary union of the wound was obtained.

Fourteen days after the operation the patient was placed in a chair. While in the chair she fainted and was put to bed again. The next day while up she had a slight attack of weakness. Three days later (July 26th) she went home, the pulsation, bruit, and thrill at the root of the neck being still distinct, but less than before the operation.

From this time she progressively improved. On June 8, 1909, nearly two years after the operation, she was examined for me by Dr. John C. DaCosta, Jr. He found marked pulsation over the old aneurysm, a fine systolic thrill, and a faint and inconstant systolic pressure murmur. Below this area he noticed a delicate diastolic shock. He recorded the second aortic sound as + and aneurysmal in quality, and found a pleuropericardial friction sound in the fourth interspace of the left side.

January 13, 1910 (two and a half years after the operation), Dr. John C. DaCosta, Jr.,

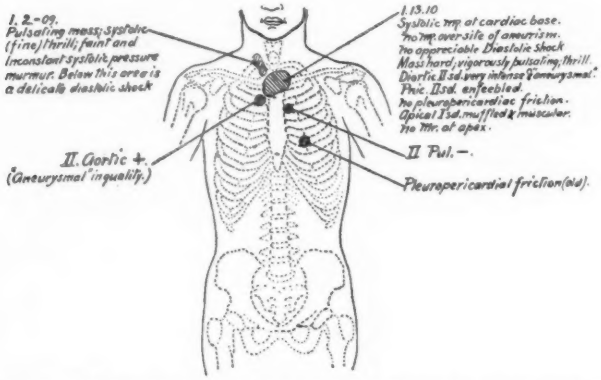
I. 2–09.
Pulsating mass; Systolic (fine) thrill; faint and inconstant Systolic pressure murmur. Below this area is a delicate diastolic shock
II. Aortic +.
(Aneurysmal inquality.)
I. 13. 10
Systolic mm at cardiac base.
No mm. over site of aneurism.
No appreciable Diastolic Shock
Mass hard, vigorously pulsating, thrill.
Diastolic II sd. very intense Aneurysmal.
Pmic. IIsd. enfeebled.
No pleuropericardiac friction.
Apical I sd. muffled & muscular.
No Mm. at apex.
II Pul. –.
Pleuropericardial friction (old).

Diagram made January 13, 1910, two and one-half years after the operation.

again examined her. He found a systolic murmur over the cardiac base. The murmur over the site of the aneurysm and the diastolic shock below had entirely disappeared. The aortic second sound was intense and aneurysmal. The pleuropericardial friction sound had disappeared. There was no murmur at the apex and the apical sounds were muffled and muscular.

I append the diagram sent me by Dr. John C. DaCosta, Jr.

THE VALUE OF THE OPERATION

Both of the cases here reported seem to have been much benefited by the operation. In case 2 the operation was more severe than necessary because of the erroneous conviction that we were dealing with an aneurysm of the carotid rather than of the innominate. The obtainable detailed record of the first ends with the twenty-second month after the operation. He lived about three years. The second patient is entirely comfortable and all the signs of aneurysm are either abolished or improved two and a half years after the operation.

Two cases do not constitute sufficient experience to enable us to be positive as to the value of the procedure, but they certainly justify a surgeon in viewing innominate aneurysm as a disease for which he may perhaps do much by operation. This view is reinforced by remembering Barwell's case and Heath's case.

There is considerable difference of opinion as to the usefulness of distal ligation in such cases.

Jacobstal and some other surgeons regard the operation as uncertain, dangerous, and though occasionally palliative, never actually curative. Le Dentu, Guinard, Imbert, and Pons assert that it can actually cure. There can be no doubt that at least it can in some cases bring about a symptomatic

cure which appears to be permanent. Matas says it does this in 22 per cent of the cases, almost one-quarter.

Double distal ligation is certainly a dangerous procedure. The mortality has been variously estimated. Statistics of mortality gathered in pre-antiseptic days are now practically useless. Matas estimates the operative death rate (from subsequent hæmorrhage and from brain complications) at 15 per cent, and says that in 30 per cent of cases the aneurysm fails to improve. In an uncertain per cent of the cases which fail to improve there are cerebral complications due to the closure of the carotid. Some surgeons maintain that 25 per cent of patients in whom the common carotid has been ligated for any cause develop brain complications, and that fully 10 per cent of cases operated upon die. The victims of aneurysm may be aged and often exhibit extensive arteriosclerosis, and in them the death rate and the percentage of cerebral complications will naturally be higher than among younger people free from widespread vascular disease. Some surgeons have tied the carotid alone, thus lessening the chance of cure and retaining the chief element of danger in the operation.

Others have tied the subclavian alone and thus lessened one element of danger and at the same time decreased the chance of cure.

Others have done the operation on one vessel first, and followed it after a distinct interval by ligation of the other vessel (consecutive double distal ligation). If this is done the carotid should always be tied before the subclavian.

Up to very recent times it had come to be accepted that the operation to be performed, if any is done, is double ligature at one seance, the carotid being tied first.

In my first case I tied the third part of the right subclavian, and I would prefer to ligate in this region in most cases. In my second case, because I made my incision expecting to tie the innominate, I tied the first part of the subclavian. This I think was a mistake and unnecessarily endangered the limb. After tying the carotid I should have exposed the subclavian in the third part of its course and applied the ligature there.

Barwell wisely insists that serious disease of the aortic valves, serious mitral disease, or decided cardiac hypertrophy are contraindications to double distal ligation, although slighter conditions of cardiac disease may not absolutely contraindicate the ligation of one vessel. Later it may be possible to tie the other vessel.

Obliteration of the left carotid, shown by absence of the carotid pulse, the facial pulse, and the temporal pulse, absolutely contraindicates ligation of the right carotid, but, as Barwell says, does not absolutely contraindicate ligation of the third part of the right subclavian, that is, does not if there is a radial pulse in the corresponding arm (Matas in Keen's Surgery, vol. v).

Aneurysm of the aorta is usually regarded as a contraindication to operation. In cases of innominate aneurysm with aortic involvement, operation

Photograph of the patient (case 2) after the operation.

certainly gives very poor results. But we must remember that Guinard ties the carotid and subclavian on the right side for certain cases of aortic aneurysm, and that Holmes has protested against refusing operation because aortic aneurysm exists. Barwell would operate if the aortic disease is sacculated, if it is limited to the aortic arch, and if it does not involve the transverse portion. He would not operate if there were fusiform dilatation of the aorta (Ashhurst's International Encyclopædia of Surgery).

There is no doubt that a large innominate aneurysm gives a worse prognosis than a small one, that operation is less likely to succeed in a fusiform than in a sacculated aneurysm, and that a recent aneurysm is more favorable for cure than an old one.

Serious visceral disease of course contraindicates operation.

The entire subject was ably reviewed in 1907 by Imbert and Pons (Archiv. Provincial Chir., t. xvii).

Should I ever have another opportunity to operate for an innominate aneurysm I would be disposed to first partly occlude the common carotid with one of Halsted's aluminum bands. The complete occlusion could be gradually accomplished, and if cerebral symptoms arose the band could be removed. After the occlusion of the carotid it would be decided if in that case it were advisable to occlude the subclavian. Were I to conclude that it was advisable, I would either tie the third part of the subclavian or gradually occlude it with a metal band.

DEPARTMENT OF TECHNIQUE

SOME OBSERVATIONS CONCERNING INTESTINAL ANASTOMOSIS[1]

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SUCCESS in intestinal operations depends upon the following:

1. General condition of patient. 2. Preparation of the patient. 3. Condition of the alimentary canal. 4. Kind and manner of anastomosis.[2] 5. Rapidity and dexterity of operation. 6. Accuracy and care of stitching. 7. Suture material. 8. Number of rows of sutures. 9. Manner of placing the respective rows of material. 10. Surgical cleanliness. 11. Character of growth removed. 12. Amount of tissue and part removed. 13. Healthfulness of tissue left. 14. After treatment.

The condition of the alimentary canal at the time of the operation determines in a measure the success of gastric and intestinal operations.

A patient prepared by limiting the diet to sterile liquids for two or three days previous to such an operation, by a thorough washing of the stomach and the removal of most of the waste products from the alimentary canal, is well fortified against any serious complications.

When the above precautions have been observed the least tension or stress is put upon the sutures and tissues making up the anastomosis.

Ever since it was found that the abdomen could be safely invaded to attack disease, much effort has been put forth to perfect a simple, safe, and satisfactory method of intestinal anastomosis.

Surgeons working for years experimentally and by actual practice with bone plates, bobbins, cylinders of magnesia, the Murphy button, special instruments, etc., have come to the conclusion that the suture method is the most satisfactory.

Many of these appliances were used by their originators with dexterity and much satisfaction. Most of them have been discarded by the skilled surgeon of to-day. The bowel clamps for holding back the bowel contents and steadying the viscus while the work is being done are about the only special appliances now used by surgeons.

The purpose of the sutures is to prevent leakage, pursing, and hæmorrhage, and to hold the loops of intestines in apposition until union has occurred. When such union has taken place, they should be absorbed or passed off into the lumen of the gut.

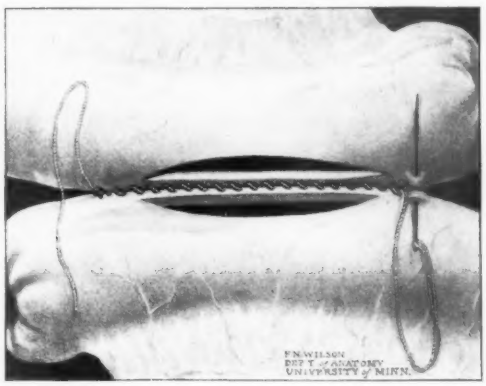


Fig. 1.

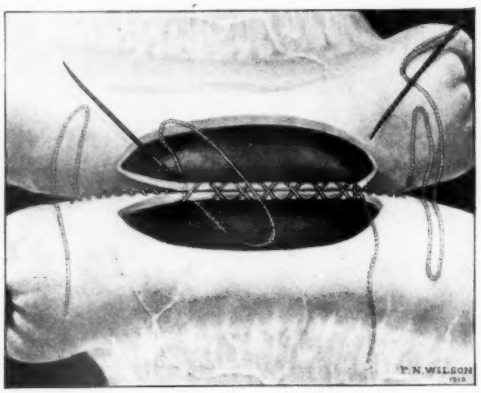


Fig. 2.

[1] Read before the Western Surgical and Gynecological Association, Omaha, Nebraska, December 20, 1909.

[2] The word anastomosis has been substituted for the word suture as better fitting the title of this paper.

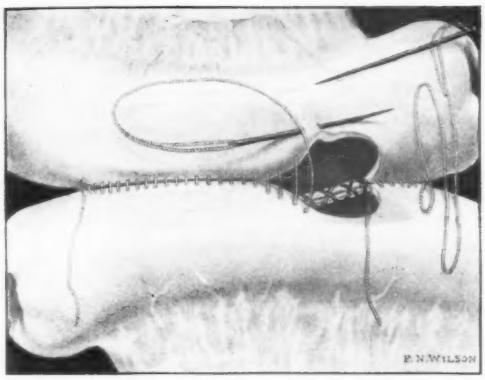


Fig. 3.

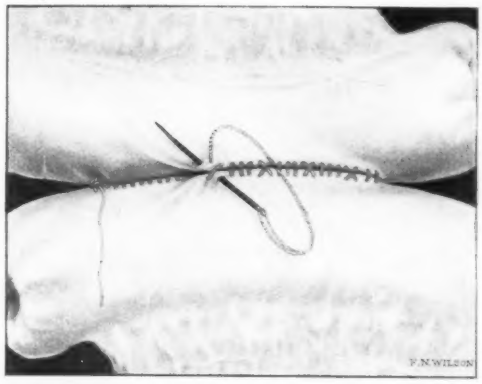


Fig. 4.

There has been much controversy over the method and manner of uniting two loops of intestines. It would seem, however, that few men now would select any but a side anastomosis, where that one is possible, as the blood supply is much better, the anastomosis is more secure and accurate, and it gives a greater percentage of recoveries.

Silk has been used for bowel anastomosis more than any other material, but Pagenstecher thread is now frequently employed and makes a good substitute.

Since we are now able to produce a sterile catgut suture, and one which will last a sufficient length of time for union of the intestines, catgut should receive more consideration.

In several experimental operations upon the lower animals, the author has from time to time demonstrated its advantages and security. In fact the use of chromic catgut for both lines of sutures has been followed by perfect results in every instance when carefully employed.

In practice chromic catgut for appendical work, to turn in gastric ulcers, and to repair small fæcal fistulæ has proved to be a safe suture. In most cases of gastroenterostomy or bowel resection, the Pagenstecher has been used within and the chromic catgut without with satisfactory results.

When non-absorbable sutures are used, they are exposed to the encroachment of the omentum or loops of bowel and numerous adhesions may form, especially if infection occurs.

It frequently happens that where a non-absorbable purse string suture is used for the appendix it causes great distress, many adhesions, lessened bowel activity, obstruction, or abscesses, necessitating further surgical work. In other words the foreign substance acts as a constant irritant, against which the tissues rebel causing no end of trouble at times.

Since the ideal result of an intestinal anastomosis is secured when there is in due time an expulsion of the non-absorbable sutures into the lumen, a method which most facilitates the accomplishment of such a result is to be favored. The nearer the suture line to the lumen of the bowel the more likely does this early sloughing take place. There is not the loss of so much bowel tissue, nor the overproduction of plastic exudate, when the non-absorbable suture is confined to the inner layer.

METHOD OF SUTURING

A suture introduced in the most rapid manner consistent with the security against leakage, hæmorrhage, or infection, to approximate like structures and to maintain the proper sized opening, is desirable. The continuous Lembert stitch is quickly introduced and gives a good appearance to the bowel, but is liable to produce pursing. It may cut out and loosen up the suture line, in case of early bowel tension, thus causing leakage and infection.

The cobbler's stitch makes a very secure and

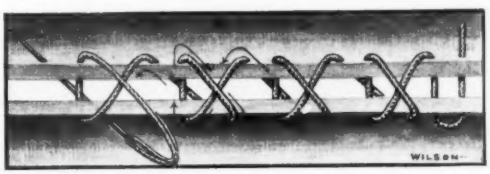


Fig. 5.

Fig. 6. Introduction of first or outside row of chromic catgut sutures.

Fig. 8. Completion of outside catgut suture (Lembert).

safe anastomosis. It does not allow any leakage of gas or bowel contents. It can be tied at short intervals making slipping impossible. On the other hand it is a slow process of suturing. A third assistant is usually required in order to do fairly rapid work. It is a very satisfactory inner stitch uniting the mucous membrane by a through and through stitch and makes the operation safe. It controls hæmorrhage perfectly and sloughs out in the course of two weeks into the bowel. It can be quickly enclosed by a continuous Lembert stitch of chromic catgut.

Cushing's suture purses some and if it pulls out the suture line may open up and permit the escape of infectious material. It is not as quickly introduced, however, as the continuous Lembert. It is very useful in turning in the mucous membrane of the upper side of the inner suture line. If a lock stitch is used in connection with this suture the anastomosis is more secure and perfect.

The interrupted suture is too slow a process and is not more secure or perfect than others. Connell's suture, when an end to end anastomosis is made, is very satisfactory, but slow.

Lembert's continuous suture or Halstead-Lembert is a very satisfactory one in approximating the serosa. It can be locked if deemed wise, by a backward stitch passing through the tissues, which does not allow puckering or slipping.

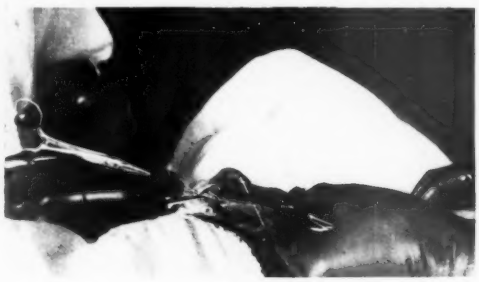


Fig. 7. Inner suture of Pagenstecher thread, continuous through and through stitch.

The backward lock stitch consists in making an overstitch with a backward stitch between the last two sutures, through the bowel coats, locking each and coming out on the opposite side a little in front of the last forward stitch (Fig. 5). It certainly makes a flawless stitch allowing no leakage or separation of tissue. The whole suture line does not loosen up if one stitch cuts out.

The inner suture line is the important one for the reason that it is completed first and determines the size of the opening between the loops of intestines. It is the one which controls hæmorrhage, and should not permit temporary leakage or infection of the outer suture line. This suture should be a through and through stitch. The backward lock stitch meets these indications and when surrounded by a chromic catgut Lembert suture an ideal result may be expected.

The outer suture or chromic catgut is absorbed and the inner or Pagenstecher's thread in due time sloughs into the bowel, leaving no foreign substance to interfere with the bowel action or to promote adhesions.

TECHNIQUE OF THE OPERATION FOR INTESTINAL RESECTION, AS SELECTED FOR ITS RAPIDITY, SECURITY, EASE, AND ACCURACY, FROM EXPERIMENTS, AND BY ACTUAL PRACTICE

The loops of the intestines desired are brought up through the abdominal wound, the part to be resected is examined. The abdominal opening and parts to be operated upon are carefully surrounded with wet gauze. All bowel contents are carefully pushed back to a safe distance and bowel clamps armed with rubber are placed upon the intestinal loops at a sufficient distance to allow enough bowel tissue to be used for the anastomosis. (In case of a gastroenterostomy long clamps armed with rubber are placed on the stomach for the same purpose.)

Fig. 9. The arrows a, a, show line of union. Chromic catgut No. 1 for outside suture (cobbler's stitch), Pagenstecher's for inside continuous lock stitch. Twenty days between two operations.

The mesenteric vessels supplying the portion to be resected are now ligated with chromic catgut No. 2, 20 day.

Pagenstecher thread is next tied securely around the intestine a safe distance from the diseased portion. No. 1, 20 day chromic catgut as a purse string suture, is placed three-fourths inch below the Pagenstecher ligature.

Clamps are placed on the ends of the diseased segment one-half inch within the ligatures, while other clamps steady the bowel near the constricting suture. The bowel is severed and the exposed mucous membrane carbolized. A blunt pointed artery forceps inverts the stumps and the purse string sutures are tied.

The loops are now brought along side. A chromic catgut suture No. 0, 20 day, on a proper sized straight intestinal needle is now introduced at the operator's end of the anastomosis and a continuous Lembert stitch is rapidly introduced, the needle being grasped each time by a forceps in the hand of a third assistant (Figs. 1 and 6). The loops of intestine are pressed closely together by the first assistant, which makes the introduction of the suture easy and rapid. This suture is continued along the bowel surfaces near the mesenteric border for about three inches.

The loops, well surrounded with fresh moist gauze pads, are now opened close to the suture line with a sharp knife and enlarged by a blunt pointed straight scissors, until the opening is made in either loop about two inches or more in length. The bowel is gently stroked towards the anastomotic opening and the field well cleared. Hot compresses lessen the bleeding somewhat.

An inner suture of Pagenstecher thread is now started first at assistant's end and a continuous back lock stitch is quickly introduced, passing through all the coats near the cut lines (Figs. 2 and 7). It is continued around the anastomotic opening, the angles safely secured by a deeper hold of the tissues. When the opposite side of the through and through stitch line is reached the assistant's thumb and index finger with sponges closely approximate the edges, the suture is so placed as to turn the mucous membrane in by a through and through modified Cushing's suture with the loops appearing on the inner surfaces of the bowel (Fig. 3).[1] When the other angle of the opening is reached it is carefully sutured with a few supplementary sutures and tied to the end left. This stitch is locked at intervals.

The needle threaded with the chromic catgut, by which the first line of approximation was made, is now picked up and the Lembert stitch is continued around the rest of the anastomotic opening, enclosing the inner or Pagenstecher suture line (Fig. 4). The loops of intestines being held by sponges in the assistant's and operator's hands, from their respective sides (Fig. 8). The angles are especially well secured and locked and the suture tied to the long end left at the beginning of the sewing. If any weak or doubtful point remains, the omentum may be stitched here with plain or chromic catgut.

Fig. 10. The arrows a, a, show line of union. Cobbler's stitch of chromic catgut No. 1 outside, lock stitch of same inside. Ten days had elapsed between the first and second operations. X, location of suture.

[1] Drawing does not represent back lock stitch used at intervals, but is placed as represented in Fig. 2.

Fig. 11. X shows where suture passed. Chromic catgut, continuous suture, occasional lock, outside Pagenstecher thread, through and through, lock stitch inside. Twenty-six days from first operation.

A secure and firm suture line is observed to be made. The parts are carefully sponged and cleaned up, the bowel clamps are removed, and the loops placed within the abdomen.

AFTER TREATMENT

The after treatment of these cases I believe to be very important. No food should be allowed for a couple of days. The more sterile the food when given the less chance is there for fermentation, distension, and infection, which may weaken the suture line. Solid food causes more pressure upon the structures. A sufficient time should be allowed after an operation for nature to throw out the plastic exudate which closes all chance of escape of infectious micro-organisms, before the bowel should be called into very active service in propelling the fœcal contents onward.

If there is much distension of the bowel the sutures may strangulate the tissues, or cut out, and so loosen their hold upon the structures. If there are any solid contents passing through the anastomotic opening early, the suture of the inner layer may be dragged out too soon.

CONCLUSIONS

1. The preparation of the patient by carefully selecting the diet, proper attention to waste product elimination, stomach washings, etc., goes a long ways towards bringing success in intestinal operations.

2. Special instruments or buttons for making an intestinal anastomosis have practically all been discarded for the suture.

3. The sutures are to prevent hæmorrhage,

Fig. 12. X shows opening in spec. of anastomosis. Twenty-seven days from operation.

Fig. 13. Direction of arrows marked a, a, indicate line of union. Chromic No. 0 catgut outside, Pagenstecher thread, back lock stitch inside. Nine days from last operation.

leakage, and to approximate like structure until a firm union has taken place, after which they should be absorbed or passed off into the intestines.

4. The side anastomosis is chosen because of the positive blood supply. It permits of a larger opening and is usually more practical.

5. Pagenstecher's or silk thread when used for the outside suture in bowel work may provoke unnecessary adhesions, calling for further operative procedures, or may cripple the action of the bowel.

6. The linen thread when used for the inner line of suture should be cast off into the lumen of the bowel after terminating its period of usefulness.

7. This inner suture should be so placed as to prevent pursing or narrowing of the anastomotic opening. The through and through back lock stitch is very suitable for this purpose.

8. Chromic catgut makes an admirable suture for the outer layer, and when used as a continuous Lembert outside of the Pagenstecher lock stitch, a safe and satisfactory union occurs.

9. Care should be observed in performing operations to avoid contamination.

10. The after treatment of the case is very important. Food should not be given too early, so as to avoid undue tension upon the suture line.

A NOTE ON SARCOMA OF BONE

By GILBERT BARLING, M. B., F. R. C. S., Birmingham, England
Professor of Surgery in the University of Birmingham; Surgeon to the General Hospital

THERE seems to be a tendency at the present time to take rather a despairing view of the future of patients operated upon for sarcoma of bone. Many of these patients have to submit to severe mutilations, and if the final results are constantly disappointing surgeons may have to reconsider the advice they have been accustomed to give in such cases. A somber picture is given by Dr. Coley in Surgery, Gynecology and Obstetrics for February, 1908, and one quite as gloomy by Dr. de Nancrède in the Annals of Surgery for July, 1909, in a paper which examines the final results of the excision of the scapula for sarcoma. I feel bound, therefore, to record some cases which afford a brighter picture. All of the patients, four in number, were submitted to the interscapulo-thoracic amputation of Berger, two for sarcoma of the humerus, two for sarcoma of the scapula, and for convenience of record I have added two operated on for sarcoma of the axilla, making six cases in all. The cases seem to me to be worth recording, not only because of the length of time some of the patients have survived, but because they illustrate two or three other important points.

Two have already been recorded in the Clinical Society's Transactions, London, vol. 31, but it is necessary here to give a brief note of each of these, as happily one of the patients is alive and well twelve and one-half years after the amputation.

Case 1. Myeloid sarcoma of the right humerus in a male aged 53. Three and a half years before admission to hospital, when swinging his right arm to strike one of his children, the patient felt something break, although the force used was very slight, and on presenting himself

Fig. 1.

Fig. 2.

at the hospital it was found that there was a fracture of the humerus. The fracture appears to have united, but some time after it was noticed that the arm was beginning to swell, the swelling slowly increased until three months before I saw the patient when the increase became very rapid. The patient had not sought advice after the fracture united because when the swelling arose he feared that if he consulted a surgeon an operation would be recommended. The condition at the time of the operation was that the upper two-thirds of the right arm were occupied by a huge tumor which increased from below upwards, in parts it was tense but firm, on other parts there was evident fluctuation. The growth encroached over the shoulder joint and obscured the outer end of the clavicle and the spine of the scapula, it filled the axilla and stretched under the pectoral muscles. The following were the comparative measurements: vertical measurement round the right axilla, twenty-seven inches, round the left, eighteen inches; girth of the right arm immediately below the axilla twenty-eight inches, of the left arm thirteen inches.

The history of spontaneous fracture, the length of time the growth has existed, its evident cystic condition, and the absence of secondary growths led to a diagnosis of myeloid sarcoma and with great difficulty the parts were removed by Berger's amputation on February 8, 1897. A fairly good recovery followed the operation but within five months it was evident that systemic infection had occurred, the growths were numerous, and the patient died a few months later.

Photograph 1 shows a section of the growth which had implicated the soft tissues up to the skin and had practically destroyed the upper two-thirds of the humerus. The microscope confirmed the view that this was a myeloid sarcoma.

CASE 2. Mixed round and spindle cell sarcoma of the humerus probably periosteal in origin, in a male aged 37.

The patient's history was one of pain in the left upper arm, duration of about seven months and of swelling which had been noticed only for about three months.

On admission to hospital a swelling of the left arm was noted which extended from just above the elbow up to and involved the shoulder joint. The swelling was firm but somewhat elastic, the parts felt infiltrated and the skin was tense. On grasping the limb firmly distinct mobility was detected at the junction of the middle and lower thirds of the humerus.

Interscapulo-thoracic amputation was resorted to February 19, 1897, as it was evident that amputation of the shoulder joint would be followed by speedy recurrence. The patient's recovery was interrupted by an attack of pneumonia but this did not disturb the healing of the wound.

Photograph 2 shows a section through the humerus. The points to be specially noted in the photograph are the extent of the growth, which shows that it had existed for some length of time, and the evident involvement of the capsule of the shoulder joint. Microscopic examination showed that the tumor was a round and spindle cell sarcoma, the round cells predominating.

This patient, I am happy to report, remains well at the present time, that is, twelve and a half years after operation.

CASE 3. Myeloid sarcoma of the scapula fungating through an exploratory incision. A girl, aged 8, was admitted to hospital February 28, 1901, complaining of a large swelling over the right shoulder blade which had first been noticed the previous September, when it was described as being the size of a hen's egg. For some weeks the part was bandaged and the patient was eventually taken to a hospital, where an exploratory incision was made into the growth; she was discharged without further interference and the parents sought advice at the General Hospital because the growth had broken through the skin.

State on admission. There was a large diffuse swelling over the dorsal aspect of the right scapula, it was ulcerated at its apex, the skin was fixed on it, the growth was immovable on the scapula though the scapula itself was movable, the axillary glands were somewhat larger than on the opposite side. A diagnosis of sarcoma of the scapula was made and there being no evidence of secondary growth elsewhere, Berger's amputation was performed on March 4th. The operation was very well borne and a speedy recovery followed.

The tumor proved to be a myeloid sarcoma, endosteal in origin and growing from about the middle of the scapula. The glands were not infected.

The patient remains well at this date, nearly nine years after the operation. She leads a very useful life and is able to do most things that a young woman can undertake, including the knitting of stockings, sewing, and house work.

Fig. 3.

Photograph 3 shows a posterior view of the scapula, growth, and shoulder joint. The opening in the skin through which the growth fungated is also shown and a partial view is seen of the growth projecting from the ventral aspect of the scapula.

CASE 4. Round cell sarcoma of left axilla. Mrs. B., aged 45, had noticed two years previously a lump the size of an egg situated to the outer side of the left breast towards the axilla, six months later she was advised to have this removed, but her husband refused his consent to the operation. The growth progressed steadily in size until the patient's admission to a Nursing Home on March 15, 1905.

State on admission. The left axilla was occupied by a tumor the size of three fists, it pushed under the pectoral muscles on to the front of the chest wall, extended right up to the clavicle and involved the skin which was adherent over an area larger than one's hand. The tumor was firm but elastic, it was tightly tied down by the structures surrounding but appeared to be movable on the chest wall and it was probable that the vessels were free, as there was no œdema of the arm and the absence of pain and paralysis indicated that the nerve trunks were also free. Berger's amputation was performed, the flaps being somewhat modified as the skin over the front of the tumor was rather extensively involved. A speedy and easy convalescence followed, but the patient died exactly a year afterwards with local and general infection.

Examination of the removed parts failed to identify any particular structure as the starting point of the growth.

CASE 5. Round cell sarcoma of the right scapula. A child, aged 10, was admitted to hospital November 30, 1905, with swelling of the right shoulder blade and loss of power in the right arm. The swelling was hard and rather tender, it filled the supra- and partly the infraspinous fossæ so that the spine of the scapula could hardly be defined, the humerus moved without the scapula but the child complained that she was unable to raise the arm more than three or four inches from the side; the extremity was wasted and soft. It was believed that something was wrong with the shoulder as long as twelve months before, as it was painful at times, but about five months before admission to hospital the pain had disappeared. The patient was a feeble, delicate looking child with slight cough and some moist sounds over both lungs, but there were no tubercle bacilli in the expectoration.

An exploratory incision was made and a small piece of growth removed for microscopic examination, it was found to be a round cell sarcoma. As the child was obviously unfit to bear a severe operation at that time she was transferred to the medical side under the care of my colleague,

Fig. 4.

Fig. 5

Dr. Simon, and was sent back to my wards much improved in health on January 8, 1906.

On that date Berger's amputation was performed and was very well borne, the shock being quite slight and a very good recovery followed.

Photograph 4 shows a vertical section through the growth and scapula, it will be seen that the tumor is one of considerable extent, its margins can be pretty well defined from the muscles around and it will be noticed that from the supraspinous fossa the growth extends into the capsule of the shoulder joint. Further investigation confirmed the view that the growth was a round cell sarcoma.

The patient remains well at this date, that is, nearly four years after her operation.

CASE 6. Fibrosarcoma of the axilla (from the first rib). A male, aged 21, was admitted to hospital on April 19, 1909, with a hard nodular swelling occupying the left axilla, the skin was becoming adherent to the surface of the tumor. The swelling occupied the whole of the axilla, it was slightly painful and sometimes the pain shot down the inner side of the left arm; on attempting to extend the arm at a right angle the growth seemed mechanically to fix the part. There was more fixation of the tumor than could be explained by mere tying down under muscles, but it was impossible to come to any certain conclusion whether this was to the rib, and if so, to which, but it was suspected that the fixation was to the second and third ribs.

The history showed that some swelling had been noticed in the axilla for about eighteen months; it increased slowly at first and then much more rapidly.

April 23. An exploratory incision was made by transverse division of the pectoral muscles and a portion of growth was removed for microscopic examination; even with a free opening of the tissues it was not clear where the deeper attachment arose, but it was believed to be from the second rib.

The microscopic report of the removed fragments showed that it was a sarcoma of low grade.

May 3. As soon as the exploratory incision was fairly healed Berger's amputation was performed; here again the skin flaps had to be somewhat modified to suit the exigencies of the case, a short anterior and a long posterior skin flap being devised.

This was by far the most difficult amputation of the kind I have performed, the difficulty being due to the fixation of the growth at its origin, which proved to be eventually from the first rib. The tying of the growth here prevented the scapula and arm being drawn away from the trunk, which is most important to be done at a certain stage of the amputation. The growth at its attachment to the first rib implicated the axillary vein. In freeing the vessel it was torn rather extensively and some air entered the vein, but happily not in sufficient quantity to cause any dangerous symptoms. With very great difficulty the vein was secured beyond the point of tearing, but this untoward event prevented me from doing what I had originally intended, namely, resecting the portion of rib from which the growth proceeded. Had the point of origin been from the second or third ribs this would have been quite feasible and indeed called for, but the relation of the first rib to the vein, and the trouble already experienced in dealing with the latter deterred me from anything more radical than a thorough cauterizing, with a Paquelin's cautery, of that portion of the rib to which the growth had been attached.

An easy convalescence ensued and so far there is not the least evidence of re-growth in the scar. Injections of Coley's fluid were given for about a fortnight after the operation but the patient then refused to continue these, although the dosage was carefully regulated so as to cause a minimum of constitutional disturbance and local discomfort.

Berger's method of amputation has steadily advanced in the favor of English surgeons, my colleague, Sir Thomas Chavasse, having been one of its earliest advocates. In my opinion it gives much better final results in many cases of sarcoma of the scapula and sarcoma of the humerus than can be attained by mere excision of the bone in the first mentioned condition, or amputation of the limb in the other. These more limited operations often invite local recurrence from the small margin of healthy tissue left after the disease has been removed, and there is instructive reading provided in Nancrède's statistics, already alluded to, for there appear to have been fifteen cases with local recurrence in sixty-five operations for excision of the scapula, and if the records were more complete it is probable that other than these fifteen patients would have been found to have suffered from local return of the disease. The risk attached to the larger procedure is very little greater than that which follows excision of scapula or amputation at the shoulder joint. I find that my surgical colleagues in Birmingham and myself have alto-

gether performed nineteen interscapulo-thoracic amputations for growth without a death, and two amputations of this kind have also been performed for traumatism, with one death from shock and sepsis, due to the nature of the injury rather than to the method of operation.

I have not had an opportunity of discovering the final results in all these cases and so present only my own with a few comments. The first patient died with rapid and wide-spread generalization from a myeloid sarcoma which had existed probably for at least four years, as he had suffered a spontaneous fracture of the limb three and one-half years before the amputation. This suggests that however mildly malignant a myeloid sarcoma may be in its earlier stages, the benign character does not persist when the growth has extended widely from its origin into tissues such as muscle and subcutaneous fat, where the myeloid cell is entirely a foreign element.

Case 3 was not diagnosed as a myeloid growth until after amputation had been effected. Had I known the exact nature of the tumor, in the presence of fungation, I should still have hesitated to resort to mere excision of the scapula. That I am conservative in the treatment of myeloid sarcoma at an early stage of its existence may be illustrated by a case which I propose now briefly to describe and illustrate.

D. S., male, aged 14, was admitted to the General Hospital December 1, 1906, with sudden inability to use his right arm. A fortnight before his admission the patient was at work and saw a piece of machinery falling and raised his right arm suddenly as though to ward it off, although he was actually some distance from the machine and could not possibly have been touched by it. As he raised the arm he felt something crack and the limb became useless. The patient was examined and though no distinct crepitus could be felt it was doubtful whether there was not egg shell crackling, and in the face of the doubt a radiograph was taken.

Photograph 5 shows at the upper end of the humerus a general expansion of the head and the adjacent part of the shaft, with a fracture at the outer side of the bone as though some of the surface layers were splitting off, and growth can be traced down the bone for nearly three inches.

The muscles of the right arm were well developed, sufficiently to greatly obscure the swelling of the bone which could hardly be recognized with certainty. The history of spontaneous fracture together with the radiographic picture suggested that the growth was a central one of the humerus, probably myeloid in nature, and seeing that the growth was of such recent development it was decided to perform a very limited operation.

Operation. An incision was made over the front of the joint which fell practically on the interval between the deltoid and pectoralis major, the capsule of the joint was opened and freely cut away, and the bone was divided about three-quarters of an inch below the lower limit of the new formation. The long tendon of the biceps was freely dealt with.

A speedy healing followed and the patient was discharged from the hospital merely with a spica bandage and a pad over the shoulder to give support. He has continued to wear a pad and bandage and in this way he is able to made considerable use of the arm, though if the bandage is taken off, his power of movement is not nearly as good.

The growth, as was expected, proved to be a myeloid sarcoma and the patient remains well at the present time, three years after his operation.

A NEW OPERATION FOR PROMINENT EARS BASED ON THE ANATOMY OF THE DEFORMITY

By W. H. LUCKETT, M. D., New York City, New York

PROMINENT ears are comparatively of uncommon occurrence. It is not sufficient to tell a mother of a child that repeatedly returns home from school crying because he has been called "donkey ears" or "sail ears," to leave him alone for such advice will not be accepted, and the odium attached to these ears and the constant harassing by his class-mates frequently is the cause of so much distress as to produce a very bad mental condition in the child as well as in the parents, and to warrant our surgical interference. This deformity occurs in either one or both auricles and in either the whole of the auricle or the lower or the upper part.

Recent writers upon this subject and articles in text-books ignore entirely the anatomy of the deformity, and for that reason describe operations that may temporarily change the so-called cephaloauricular angle, but will be followed by neither a permanent result nor by a restoration of the normal anatomy of the ear. In order to understand the operation herein described it is necessary for us to enter into the anatomy of the auricle or pinna to a certain extent.

To a careful observer "donkey ears," or prominent ears, means something more than an increase in the cephaloauricular angle as suggested in recent text-books on surgery; it means a deformity

Fig. 1. Fig. 2. Fig. 5.

Fig. 1. Schematic horizontal section of a normal auricle just above the level of the auditory canal.

Fig. 2. Schematic horizontal section of a prominent ear, showing absence of the fold in the cartilage that forms the antihelix.

Fig. 5. Schematic section of auricle after completion of the operation; sutures in cartilage and skin of reconstructed antihelix.

of the ear itself, a change in its topographical anatomy. Rarely have I observed a perfect ear, anatomically, set at so great an angle from the head as to attract attention.

The external surface of the normal auricle is irregularly concave, and presents for examination several well marked depressions and elevations which depend for the most part upon the same depressions and elevations in the underlying cartilage. The concha, the largest and the deepest of the concavities, surrounds the entrance or meatus to the external canal. This funnel-like fossa is subdivided by an obliquely transverse ridge, the crus helicis, which runs forwards and upwards curving backwards and downwards along the curved margin of the auricle forming the helix and terminates just above the posterior margin of the lobule in the cauda helicis. The second elevation, the antihelix, which is in front and parallel to the helix, is a curved ridge which begins at the antitragus below, forms the concave posterior boundary of the concha and divides above it into the superior and the inferior crus between which lies the fossa triangularis or fossa antihelix. A horizontal section through the auricle just above the level of the auditory canal shows that the cartilage of the concha bends outwards at a right angle from the head until it reaches the antihelix, which it forms by being folded backwards upon itself. Fig. 1.

Now in most prominent ears which are characterized by a bending forwards of the auricle, either the antihelix is undeveloped or entirely absent, the concavity of the concha being continuous with the concavity or fossa of the helix. Fig. 2. In those cases of prominent ears characterized by a drooping of the upper part of the auricle we have the concavity of the concha continuous with the fossa triangularis and the fossa helicis, both intervening ridges of the crura antihelicis being absent or in some lesser deformities of the upper part of the ear only the upper ridge of the crura antihelicis may be absent. These ridges, the antihelix and the crura antihelicis are simply a fluting, bending, or folding of the cartilage, and are apparently intended as trusses for supporting the flexible ear.

The operation as described and illustrated here is for the purpose of reconstructing the fold or truss of the cartilage recognized as the antihelix in ears turned forwards, and the same principle is applicable for the reconstruction of the superior crux of the antihelix for the so-called drooping ears, or of both together when necessary.

Because the integument is more freely movable, and the sutures more easily passed, and the resulting cicatrix practically invisible the inner or posterior surface of the auricle is chosen for the operation. A crescentic incision is made through the integument opposite to the line of the intended new or reconstructed antihelix. The inscribed integument is removed; the edges of the skin are now dissected free from the cartilage and retracted. Fig. 3. A similar crescentic segment is removed from the cartilage, care being exercised in incising and excising the cartilage not to buttonhole the skin on the external surface of the auricle. The skin and the cartilage are now sutured separately, and it is the method of suturing the cartilage that is emphasized.

The cartilage suture is passed from the cranial side from within out and back again, Fig. 3, care being taken not to perforate the skin on the external surface, then crossed over the excised portion and passed on the other side from within out and back again as a Lembert suture, in such a manner that when the suture is drawn tight and tied, not the edges but the sides or flat surfaces of the cartilage will be in apposition. Figs. 4 and 5. The edges have been turned forwards or outwards to form the antihelix and at the same time the helix is set closer to the cranium thus diminishing the cephaloauricular angle.

Four or five interrupted sutures are usually enough for the cartilage. A so-called fistula, one half circle needle is best for the cartilage. The skin is sutured with horsehair and leaves a very small cicatrix.

The greatest care must be exercised in asepsis as the slightest infection may set up a perichondritis and an auricular perichondritis usually results in a deformed, thickened, corrugated ear. Also care must be taken in the hæmostasis. There are

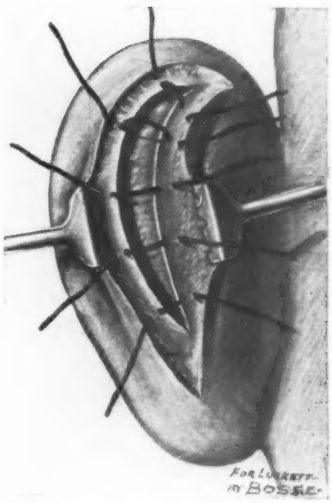


Fig. 3. Showing removed section of cartilage, retracted skin, and method of passing sutures on the inner or posterior surface of the ear.

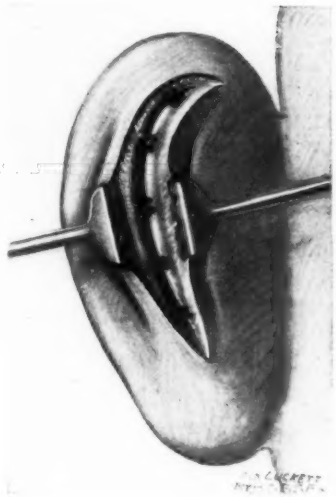


Fig. 4. Showing folding of cartilage after sutures are drawn tight and tied.

no large vessels encountered, and usually the continuous pressure of the artery clamp during the operation is sufficient. It is well to avoid ligatures, but when they must be used only the finest and a single tie is sufficient. A hæmatoma auris is quite deforming.

The width of the crescentic segment of the cartilage to be removed depends upon the size of the ear, and the thickness of the cartilage. In macrotia a large section is removed. In microtia a small section or no section at all is removed, only an incision is made to facilitate the turning outwards of the edges of the cartilage.

In an ear with a very thin flexible cartilage I think it would be possible to reconstruct the antihelix and set the helix close to the head without excising a segment or even incising the cartilage, simply by fluting or folding the cartilage at the proper site, and passing the suture in such a manner as to maintain the fold.

ANOMALOUS KIDNEY (NEPHRECTOMY)

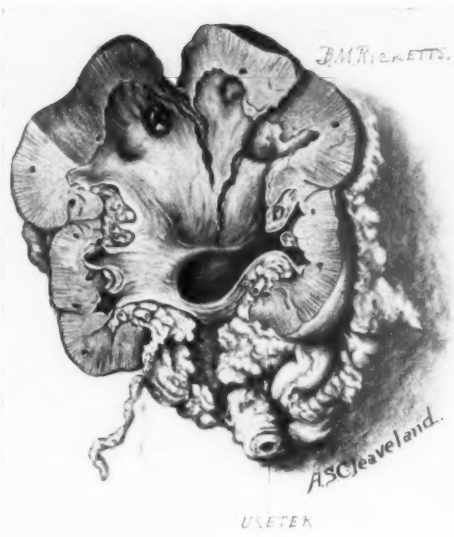
By BENJAMIN MERRILL RICKETTS, M. D., Cincinnati, Ohio

THE accompanying illustration is of the left kidney, removed from a female, about thirty-five years old, for pus in the urine and the symptoms usually associated with pyonephrosis.

Two operations, the first a nephropexy, and the second a nephrotomy, were done by a competent surgeon, about six and ten months respectively, before I made the nephrectomy. Being much in doubt as to the presence and character of the two kidneys, a median incision was first made through the anterior belly wall. The right kidney was found normal in size and position, while the left kidney could not be felt through the dense mass of adhesions. A posterior incision was made extending down upon the firmly fixed kidney With my left hand within the peritoneal cavity, pressing firmly upon the mass and my right fingers separating the kidney from the adhesions posteriorally, it was with great difficulty delivered posteriorally and removed. Provisionary drainage was continued about five weeks, with recovery uneventful.

Remarks. The kidney was about one-third the size of its mate, irregular in shape, devoid of a renal artery and vein, and about ninety per cent or all of its function.

It was an anomalous kidney, probably having never functionated but slightly if at all. Small



vessels can be seen here and there, giving evidence that the kidney was nourished by vessels by the mass of adhesions. There is every evidence that the absence of the main vessels is due to embryological and not surgical defects.

While the kidney was abnormal in shape, there is a possibility of its having had a renal artery and vein before the first or even the second operation, and that the degree of infection was much greater, but this is hardly probable. Its vitality was low, but infection never present until after nephropexy. The nephropexy caused continued lessening of vitality which resulted in infection. The true condition probably could not have been detected at the first operation, but pus was removed from the kidney at the second operation.

If the true condition could have been known at the time of the first operation the kidney should have been removed. Pus being found at the time of the second operation should have at least caused hesitation in permitting the kidney to remain.

So far as can be determined the right kidney is normal. The case is reported because of its unique character.

A CASE OF VENEREAL PAPILLOMATA

By H. A. MOFFAT, F. R. C. S., Cape Town, South Africa

THE accompanying photograph does not require much explanation. The patient was a colored man of about twenty-one years; he had had gonorrhœa about two years previously and had no treatment. He came to the hospital in the condition depicted. History was vague. There was no urethritis and no signs of syphilis. Completely encircling the anus was a huge soft papillomatous growth the size of an average head. The attachment was to the skin round the anus for about two inches from the muco-cutaneous junction. The scrotum was free; there were large warty growths on the prepuce. The motions came through the center of the large mass. The glands in both groins were large. His general condition was good, and I could find nothing else wrong with him.

An attempt to remove it with the knife failed; bleeding from large, thin-walled vessels was so profuse and difficult to control that I had to put him back to bed with half a dozen clamps on the incision and the tumor not removed.

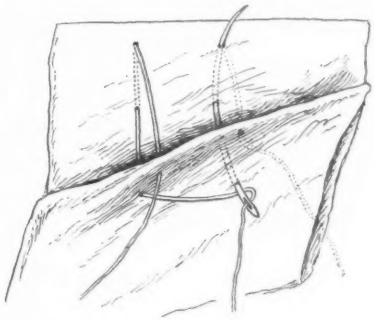
Ten days later with the electro-cautery it was easy to remove with but trifling loss of blood.

My accumulators failed when half the tumor was removed, and I had to complete it a week later. He was skin-grafted subsequently, and went out without his encumbrances, and quite well.

A USEFUL STITCH FOR OVERLAPPING FASCIA IN THE CLOSURE OF ABDOMINAL WOUNDS

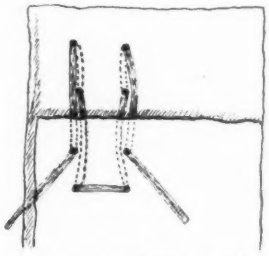
By C. C. NORRIS, M. D., Philadelphia, Pennsylvania
Instructor in Gynecology, University of Pennsylvania; Attending Physician Maternity Hospital

THE advantages of closing abdominal wounds by the layer method with tier sutures is too well-known to need comment. One of the superiorities of this method of closure is the facilities it offers for the overlapping of fascia. The

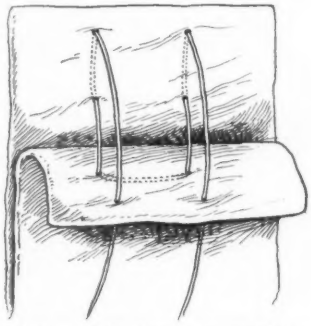


No. 1. This shows the stitch nearly completed. By using a long needle and passing it through and through the stitch may be inserted very rapidly.

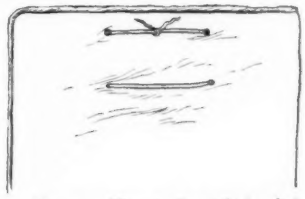
above illustration shows a stitch which is particularly adapted for this purpose.



No. 2. This shows the stitch in place. By tightening the suture preparatory to tying the overlapping will be accomplished.



No. 3. This shows the stitch in place. For purposes of demonstration the overlapping fascia has been turned back.



No. 4. Shows the stitch tied. Note that the stitch has not been tied so tightly as to cause puckering.

The points in favor of this stitch are: 1. It positively overlaps the fascia. 2. It does not constrict tissue and thus interfere with union. The stitch is a quadrilateral one and no matter how tightly it is tied two borders of the quadrangle are unconstricted. 3. A comparatively large area of fascia is brought into apposition and this not only produces firm union but lessens the number of stitches required. 4. As a moderate amount of fascia is taken up with each passage of the needle, and as the stitch is as it were a double one, tearing out is extremely unlikely. 5. By passing the needle through both fasciæ at once, as shown in Fig. 1, the stitch may be inserted with great rapidity. When the stitch is tied it should form a square, each side of which measures about one-fourth of an inch.

In the lower abdomen in the median line, the deep layers of the superficial fascia are supplied by the superficial epigastric and the superficial circumflex iliac, chiefly by the former, while the rectus and its sheath receive their blood supply from the deep epigastric, which anatomoses into the internal mammary. The branches from all these vessels are quite tortuous, but may be said to have a general obliquely upward direction; in other words, the blood supply of the fascia of the rectus comes from various directions and is with this stitch interfered with to a very small extent.

In closing abdominal wounds with tied sutures it is important that the stitches should not be tied too tightly, good approximation is all that is required; tight tying does not add to the strength and by producing puckering will lessen the neatness of the closure.

THE TUBERCULIN BLISTER REACTION

By HERBERT DE CARLE WOODCOCK, M. R. C. S., L. R. C. P., D. P. H.
Honorary Consulting Physician to the Armley Sanitorium, Leeds, England

I WAS captivated by the simplicity and efficacy of the Calmette conjunctival reaction for tuberculosis. It was French and brilliant. Moreover, it was backed by the name of a great scientist.

But among 600 applications I met with two very serious results, and my first halt was called when a morose patient suggested pecuniary compensation for suffering and loss of work. I was tempted, however, to continue the test, on account of its great convenience, especially as my severe reactions had so far been confined to adults and in them to cases of tuberculosis of the bones and glands.

Lately I have not only relinquished the use, but almost buried the memory of the Calmette test. I was helped to this attitude by a case I saw in the practice of a medical colleague.

The patient in question, twelve hours after the application of Calmette, was prostrated with a severe conjunctivitis, extending in one part to an episcleritis, which prevented his leaving his house for a week; during the second week the control eye became inflamed. Three months elapsed before he was well. Mr. Teale, the eye surgeon, saw him in consultation and photographed the condition. The representations are here given and depict the condition of the eyes three weeks after the application of the "Calmette."

For a little short of three years I had been using the blister reaction for my hospital patients. In private practice I had preferred the more ready conjunctival reaction until the experience above mentioned. I have limited myself since then to the blister reaction in all cases.

I produce two circular denuded surfaces on the skin of the chest, one on each side of the skin of the sternum. In effect I transfer my patient's conjunctiva to his chest wall.

This is the method:

I cleanse the skin with ether and apply two similar blister plasters, each about one-third of an inch broad by one-half an inch long to the chest wall.

The blister plasters are left on for eight hours, the raised epidermal surfaces are then clipped off. The denuded surface is next treated with water dressing for a few hours, or at once washed with ether and carefully dried with a sterilized swab.

To one of the denuded surfaces I apply a piece of sterilized oiled silk, on the under surface of which is one drop of Koch's O. T. undiluted.

I speak of one drop, but 1 cc. of Koch's O. T. will suffice for thirty reactions.

The upper surface of the oiled silk is then *gently rubbed for half a minute*, and by this means the

Photograph showing condition of both eyes three weeks after application of Calmette to left eye.

tuberculin is pressed onto and into the raw surface below. The oiled silk is not removed until the following day. The control blister is treated in exactly the same way, save that no tuberculin is applied to the oiled silk.

In from 12 to 36 hours the raw surface to which the tuberculin has been applied is rosy red and possibly covered with a thin layer of pus; the margin is surrounded by an erythematous halo.

The control blister shows, by comparison, an envious pallor; there is no halo.

In some cases the tuberculin reaction is excessive but no harm is done, the skin is being dealt with, not the conjunctiva.

There is never any doubt about the reaction; if the test is positive it is emphatically positive.

For weeks after, the skin around the positive "blister" is abnormally sensitive; the slightest pressure and it blushes. Yet the denuded surfaces both heal within a few days. Although I have used the test more than 500 times I have not found scrofulous changes about the skin lesions or any of the other troubles which users of the Von Pirquet scratch reaction occasionally bewail. Pustules are seldom seen around the blister.

The deeper layers of the skin are not reached. I have in a few cases found a second blister test to be positive when the first has been negative. I do not attach anything like the value to the second reaction that I do to a first; cases in point have not been clinically tuberculous.

The advantages of this reaction are:

The blistered surface allows rapid absorption.

The reaction is vivid (and I may add it fades slowly).

The raised epidermal surface carries with it surface bacteria; the two "blisters" being similar in size and presumably in activity give similar (i. e. as to depth and extent) surfaces.

The "blister" removes the drier, scaly, greasy, or atrophic layer of skin; it opens up the absorbents without penetrating into the deeper skin layers.

It is remarkable, but nevertheless true, that the control "blister" never shows any surrounding inflammatory erythema if the skin is well cleansed before the application.

The reaction in some cases appears to accentuate the signs of any local pulmonary or other local tuberculous lesion.

The reaction may be expected if the patient is tuberculous and not in extremis.

It has been said that the very showiness of the reaction indicates an unnecessary absorption of tuberculin, and I have seen one evil resulting from this, namely, that a person having previously been tested with Calmette and having reacted positively has been apt to have a return of the conjunctivitis when my blister test has been applied to the chest wall. On the occasion of my showing fourteen blister tests at the Leeds Infirmary, two of the patients exhibited conjunctivitis from this cause. Without stopping to theorize on this fact, I may add that the absorption of tuberculin from a blistered surface is of therapeutic value. I have seen patients improve, especially in weight after the application of one drop of O. T. to a blistered surface. Surely, I have said, this improvement is not due to "suggestion." Wishing to get an authoritative opinion on this point I wrote to Dr. Philip of Edinburgh. He replied that he had already thought of some such therapeutic measure and he advised a continuance of the investigations. Since this communication I have blistered my cases of lupus, and applied the tuberculin. The reaction is excessive, greater than when tuberculin is applied without the preface of a blister. The benefit is commensurate with the reaction.

Thousands of patients have been treated with hypodermic injections of tuberculin; only a few have been treated by the application of tuberculin to a blistered surface. It is impossible, therefore, to compare. But the subject is to me fascinating, possibly too fascinating. I commend it, therefore, to others, who doubtless will approach it in a more critical spirit.

A CASE OF PUERPERAL BACTEREMIA TREATED BY THE INTRAVENOUS INJECTION OF MAGNESIA SULPHATE

By R. R. HUGGINS, M. D., Pittsburg, Pennsylvania

FOR some months the writer has been using magnesia sulphate in the treatment of puerperal infections.

A series of experiments both in animals and in the human have demonstrated that the administration intravenously of this salt is safe and that it is a valuable therapeutic agent in the treatment of infection when given in this manner.

When indicated, the above treatment is supplemented by a continuous intrauterine irrigation of a solution of magnesia sulphate. A full report of the study, dosage, methods, etc., will appear later.

So far as the knowledge of the writer goes this is the first report of the intravenous use of magnesia sulphate.

The case here reported was selected because it was unusually severe. Also it presented the interesting complication of involvement of the iliac glands during the stage of convalescence.

Name, Mrs. G; F. H., negative; P. M. H., health has always been normal.

Menstrual history: Began at the age of thirteen. Has always been regular. Periods of duration from three to four days. No pain, and flow normal in amount.

Pregnancies: First pregnancy occurred 18 months previous to admission to hospital. Nothing unusual during the pregnancy, and delivery was a normal one. Two weeks ago an abortion occurred at about the second month.

Patient admitted to hospital December 8, 1909. She gave a history of fever, sweats, and chills covering a period of ten days. Patient presents an appearance of extreme anæmia, hæmoglobin of 45. Lungs and heart normal. Liver and spleen negative. There is no tenderness over the abdomen. Patient complains of no pain in the pelvic organs. Pulse rapid, and general appearance of the patient is one commonly seen in the presence of profound sepsis.

SPECIAL NOTE.

Muco-purulent discharge from vagina. Laceration of the perineum, cervix is enlarged and lacerated on the left side. Body of the uterus slightly enlarged and retroverted. There is no thickening or infiltration in or about the adnexa. On the left side of the uterus there is a small mass extending from the uterus into the perimetrium. Its upper border is on the level with the superior border of the broad ligament, and its lower border on the level with the internal cervical opening. It is about two cm. in thickness, extends to the outer wall of the pelvis, and suggests the extension of the infection directly through the pelvis, via the lymphatics. There is very little tenderness, and careful examination reveals no evidence of any pus formation. The blood culture taken shows streptococcus in pure culture at the end of 48 hours. Diagnosis, puerperal bacteremia.

December 10, 1909. Forty-eight hours after admission patient was given magnesium sulphate (grains 25) in 500 cc. of normal salt solution intravenously. Solution was allowed to run into the vein slowly during the course of about forty-five minutes. Temperature since admission had varied between 102 and 104.6; pulse from 115 to 120. Her physician states that previous to admission to the hospital the pulse and temperature had been running at this rate for about one week, accompanied by frequent chills and sweats. Following the administration of the magnesium sulphate temperature rose to 104 and then fell to 97, where it remained for about six hours, again rising on the evening of the day following to 104. The pulse somewhat lower and improved in quality.

December 13, 1909. Twenty-five grains of magnesium sulphate in 500 cc. of salt solution was administered intravenously, followed by a rising temperature, and again a fall to 98. From this time there was a gradual improvement in the condition of the patient in every way, temperature reaching 99 on the 16th, eight days after admission to the hospital.

December 25, 1909. Patient began to complain of pain in the left leg. On examination, the limb was found œdematous and the saphenous vein could be felt as a tender firm cord ascending to the femoral opening.

December 29, 1909. Patient still complains of great pain in left leg. Greatest point of tenderness is over the saphenous opening, from the lower border to Poupart's ligament. Pulse and temperature elevated.

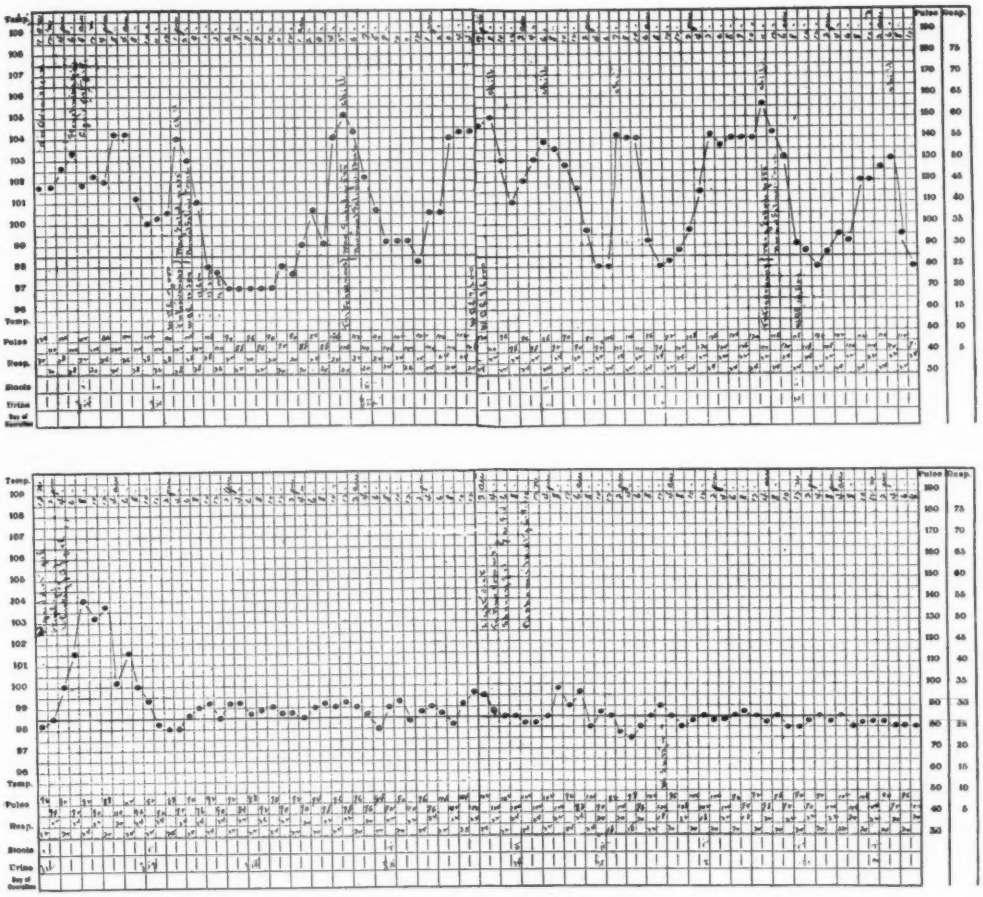
January 6, 1910. For the last ten days patient's temperature has been elevated to 102 or above Swelling at the upper end of left thigh has remained approximately the same. Thigh is fully twice the normal size. There is great tenderness on pressure about the swelling, which extends about one-third the distance to the knee. There is no tenderness in the abdomen; no nausea; no fever.

January 7, 1910. Dr. Miller made an incision about seven cm. long below the left trochanter. The fascia lata was divided, and the whole explored with the finger. No pus obtained. Tissues felt indurated, œdematous, and considerable quantity of blood and serum were evacuated. Cigarette drainage.

January 10, 1910. Patient has been greatly relieved since the operation. Drains removed. There was considerable reddish serous discharge from the wound. Patient continued to improve, and convalescency firmly established. The wound continued to heal nicely.

January 27, 1910. Patient's temperature began to rise, and she complained of considerable pain in the left lower quadrant of the abdomen, the point of greatest tenderness being immediately above Poupart's ligament, extending upward, and apparently located behind the peritoneum, along the course of the deep vessels. This continued without any improvement. Bimanual examination showed no involvement of the tube or ovary on this side, but there was apparent thickness posteriorly, and a diagnosis of involvement of the iliac glands was made.

February 28, 1910. An incision was made parallel to and about 3 cm. above Poupart's ligament. The abdominal wall was divided, muscles, and fascia in direction of the fibers down to the peritoneum, which was pushed



The above charts show the temperature for fifteen days after admission to the hospital. At the end of this time blood cultures showed the absence of streptococci in the blood stream.

aside. Iliac glands were found enlarged, extending upward along iliac vessels as far as the finger could be carried. A regular chain of elastic-feeling glands. These were removed. No definite abscess was found. The wound was partially closed with silkworm gut and drained. Since this time the patient has made an uninterrupted recovery. Temperature and pulse remain normal. Discharged from the hospital March 25, 1910.

TRANSACTIONS OF SOCIETIES

AMERICAN SURGICAL ASSOCIATION

TWENTY-EIGHTH ANNUAL MEETING HELD AT WASHINGTON, D. C., MAY 3, 4, AND 5, 1910

OPERATIONS ON THE HYPOPHYSIS

PROFESSOR FREIHERR VON EISELSBERG, of Vienna, Austria (Abstract from the original paper by Carl Beck, M. D.): Even the smallest of the ductless glands like the parathyroid and hypophysis have important physiological functions. It is known that the total extirpation of the latter is fatal to the animal. The removal of the anterior part seems to affect the animal differently than the destruction of the posterior portion. Clinically the experiences have shown two more or less distinct types in pathological changes of the hypophysis; one characterized by the well known picture of acromegaly, while the other could be described as adiposegenital degeneration. It is essentially a complex of symptoms; headaches, vomiting, epileptic seizures, changes of the optic nerve, maldevelopment of mammæ in woman and hypertrophy of the same in men, abnormalities of pair development, drowsiness, etc. Pathologically the changes have been found to be carcinoma and sarcoma, in many instances only cysts.

After anatomical and experimental studies by Löwe and König, Schloffer of Insbruck operated upon the first case on the continent in March, 1907. Prof. von Eiselsberg operated upon his first case four months later and his second in December, 1907. Since that time a number of cases by Eiselsberg and several operators in America, among them Cushing, Halstead, Mixter, Kanavel, and others, have been published.

Eiselsberg's cases are divided into three groups:

1. Three cases of hypopituitarism, a clinical picture as described above; all cured.
2. Two cases of acromegaly; both died.
3. One case of combination of both; improved materially.

The detail of the histories of the cases showed that the diagnosis in most instances was clear and pointed directly to pathological changes of the hypophysis, besides the characteristic skiagraph showed the destruction of the sella turcica.

The result of the operations was in the cases which survived the operation, a partial or total disappearance of the symptoms, notwithstanding the fact that not all the pathologically changed tissue was removed by the operation. This led Eiselsberg to believe that the pressure upon the normal structures was the cause of the symptoms, hence the removal of only a part of the tumor is followed by relief or apparent cure.

As to the technique, Eiselsberg prefers the nasal route. He is well aware of its difficulties and disadvantages, the necessity of approaching an aseptic and highly sensitive area through an absolutely contaminated field and the depth of the operative field, but he considers the intracranial method still more dangerous. He is inclined to believe that gradually he will be able to dispense with the temporary resection of the nasal skeleton and that he will be able to enter the affected region without external incision through the mouth, though it remains to be seen whether this be a decided advantage, since it may not give such an easy access to the field of operation. Hirsch of Vienna removes the contents of the nasal cavity in several sittings as a preliminary action, and the same method seems to have been followed by West.

From what Eiselsberg has seen in Cushing's clinic, he was very favorably impressed by the intrabuccal route, similar to the method of Kanavel and Halstead, and he will give it a trial, though in his last cases the temporary resection has not resulted in any bad deformity.

One plea is to be made as in all such conditions, and that is the plea for early diagnosis which will bring these cases to the surgeon early enough to prevent the lamentable cachexia of these patients afflicted with the disease of the pituitary body.

Prof. von Eiselsberg closed his highly interesting and valuable report before the Congress of Surgeons in Washington with the expression of his satisfaction with the progress of American surgery and institutions, and with the inspiring words: "I believe that the personal exchange of views and ideas of men of foreign lands and nations not only cultivates science but personal and lasting friendship among the men, and that these ties bring the civilized nations into closer harmony and are in-

strumental in the development of the universal peace among the same."

TECHNIQUE OF OPERATION FOR REMOVAL OF TUMOR OF THE HYPOPHYSIS

DR. A. E. HALSTEAD, of Chicago, read a paper with this title. (See SURGERY, GYNECOLOGY AND OBSTETRICS, May, 1910.)

DISCUSSION

DR. S. J. MIXTER, of Boston: I wish to present a case operated on by the route suggested by Dr. Kanavel. There was a large cyst in the hypophysis filled with cholesterin and holding about one and a half to two ounces of fluid. Patient made a good recovery after the operation and his vision, which before was extremely poor, has been much benefited.

DR. HARVEY CUSHING, of Baltimore: The various means of approach to the hypophysis do not make so much difference as does the matter of dealing with the structure when it is brought into view. The growth often becomes malignant, as is true of long standing trouble with the thyroid, and it is conceivable that it cannot be entirely removed. In fatal cases it has often been found that only a mere fragment of the growth has been taken away. The operation in the first place has for its object the relief of pressure; these symptoms can be combated by the mere removal of the lower part of the sella turcica and the splitting of the capsule of the gland. Whether many of these adenomas are merely hypertrophies of the gland comparable to various diseased changes in the thyroid we do not know, but if so partial removal is indicated.

DR. ALLEN B. KANAVEL, of Chicago: Concerning the technical procedure in Dr. Halstead's cases, in the first one particularly the view could not have been better. The operation was very quickly done, the anterior wall of the sphenoidal sinus quickly removed, and the bulging sella turcica opened, and a tumor protruding into the sinus was removed without difficulty. In the second case the sella turcica did not bulge into the sinus, it was seen with more difficulty and was arrived at by anatomical deductions. In two cases there was considerable hæmorrhage and I would suggest the elevation of the head during the operation. In the majority of cases it will only be necessary within the nose, to remove the vomer and the anterior portion of the sphenoid in order to come down on the sella turcica.

DR. DEAN LEWIS, of Chicago: The tissue removed from the first case contains no elements which are ordinarily found in the anterior lobe or the pars intermedia. The tumor is composed of stratified epithelium with a papillary arrangement. The lower cells rest upon the stroma of the papillæ and are cylindrical, while the cells of the succeeding layers differ in shape; the differences apparently being due to variations in pressure. As the cells of the anterior lobe and the pars intermedia are not reproduced in this growth, we must assume that the tumor has probably developed from an epithelial inclusion, which has not gone on to complete differentiation. The growth corresponds histologically to a group of tumors which occur about the infundibulum and extend down to the sella and up to the third ventricle.

The tissue removed from a second case came from the anterior lobe. In some sections the cell columns are cut parallel, long rows of cells resting between rather thick connective tissue trabeculæ. In other fields the cell columns are larger than normal; the connective tissue between the different columns having broken down, thus permitting of fusion. In still other fields the fusion has become so marked that large groups of cells are found, hyperplasia apparently having ended in adenoma formation. Karyokinetic figures may be seen in a number of different fields.

It is important to recognize the complex structure of the hypophysis in making the anatomic diagnosis of tumors of this gland, and to remember that the cells of the anterior lobe, when growing rapidly, tend to reproduce the structure of a sarcoma. Stains which differentiate granules should therefore be used in the study of all growths apparently originating in the hypophysis.

BENIGN BONE CYSTS (OSTITIS FIBROSA), GIANT-CELL SARCOMA AND BONE ANEURYSM OF THE LONG PIPE BONES. A CLINICAL AND PATHOLOGICAL STUDY WITH THE CONCLUSION THAT CONSERVATIVE TREATMENT IS JUSTIFIABLE

DR. JOSEPH C. BLOODGOOD, of Baltimore: In many lesions technique is ahead of diagnosis. The development of technique is more rapid, because the results of faulty technique are immediate, while the development of diagnosis is more difficult, especially in tumors, because the results are more remote.

Treatment of tumors which will assure the patient the greatest possibility of a permanent cure with the least mutilation will only be accomplished when surgeons have a better conception of the local growth of neoplasms, both benign and malignant. This is especially true of the three lesions of the long pipe bones which I wish to present in this contribution.

The so-called benign bone cyst may present itself in five forms: first, as a medullary cyst without any definite gross lining; second, as a similar cyst with a definite connective tissue lining which is easily stripped from the bony capsule; third, as a medullary mass of fibrous tissue with a small cyst; fourth, as the same medullary mass of fibrous tissue without any cyst formation; and fifth, as multiple medullary cysts.

Among 89 cases of which 20 were personally observed, 69 belong to the variety of true localized bone cyst or ostitis fibrosa. The other 20 cysts have different etiological factors, for example, cysts in enchondroma, in pure myxoma, in giant-cell sarcoma, in ostitis deformans; cysts due to subperiosteal ossifying hæmatoma, and callous cysts.

The true benign bone cysts are pathologically identical. In the cases with no definite lining there is found under the miscroscope between the bone lamellæ of the bony shell the same connective tissue seen in the gross in the other four types. This connective tissue has a definite histological appearance which has been, but should not be, mistaken for spindle-cell sarcoma. In a certain number of cases areas of giant cells are found, but they should not be interpreted as giant-cell sarcoma. Also, one will find, in the gross and with the microscope, islands of cartilage.

At the exploratory incision there is always a thin shell of bone; the contents of the cyst is usually of a dark-brown color and thin; it has never been distinctly hæmorrhagic with large blood clots as the contents of the so-called bone aneurysm. The character of the fluid and the gross appearance of the fibrous tissue should allow one to differentiate this lesion whether it appears as a cyst or a completely solid area. This lesion has been and can be cured by simple incision and curetting. It is distinctly benign, and from an experience over many years with 69 cases it has shown no tendency to malignancy.

The giant-cell sarcoma of which I have studied personally 19 cases can also be recognized at the exploratory incision. The medullary cavity is filled with a soft, hæmorrhagic tissue resembling granulation tissue mixed with whitish areas which, when removed with the curette, come away in masses of irregular shape. This tumor also has been cured by curetting. It is 8 years since I curetted from the medullary cavity of the upper end of the tibia such a tumor, and this patient has no evidence of recurrence to-day. Among my personally studied cases and in the literature I have so far been unable to find metastasis from a giant-cell sarcoma. Cases have been cured even after repeated curetting; amputation is only indicated when the patient has allowed the tumor to grow to such a size that it has perforated the bone capsule and infiltrated the soft parts to such an extent that its complete removal would leave a functionless limb. Even in such cases I believe it will be justifiable to first attempt curetting, use the Paquelin cautery, followed by X-ray treatment. But such extensive cases are unusual. The point that I wish to emphasize is that giant-cell sarcoma can and should be recognized at the exploratory incision and in the majority of cases an attempt should be made to cure the disease with the curette.

The so-called bone aneurysm is a much less frequent tumor. It is distinctly malignant. It is a hæmatoma due to hæmorrhage in the most malignant form of medullary spindle, round, or mixed-cell sarcoma, and I am of the opinion that in this stage of this tumor metastasis has already taken place, so that no harm could come from mistaking such a tumor for a bone cyst or giant-cell sarcoma. I have seen 3 cases. In 2 the diagnosis was not difficult, one patient was not saved by the highest amputation; in the second case amputation was refused; the third case was first treated as bone cyst, amputation was done later, but the patient died of metastasis.

DISCUSSION

Dr. Rudolph Matas, of New Orleans: I would call attention to a case in which after removal of a giant-cell sarcoma from the humerus there was such a large cavity that I used about an ounce and a half of Mœsetig-Moorhof cement, and the patient later developed extreme symptoms of iodoform poisoning, as was but natural from the large amount of the cement used. In ten days, however, he recovered from its effects and the arm healed with a perfect contour of the bone. I believe that in Beck's paste we have a most valuable means of filling up cavities, it being superior in my mind to any other paste.

Dr. William L. Rodman, of Philadelphia: I recall a case operated upon in 1889 for large giant-cell sarcoma of the lower jaw by free chiseling and curettement but without removal of the maxilla. The patient lived for more than ten years after this operation, and may be alive to-day.

Dr. Joseph A. Blake, of New York: I had a case of sarcoma of the bone, the fourth finger of the patient being diseased. A simple operation in this case proved most satisfactory, and now, three years since operation, there is a normal phalanx.

Dr. Harry M. Sherman, of San Francisco: I would say that in my experience salt solution, poured into these cavities a little in excess, just

before the last stitches are taken is as good as any other material for filling; it is replaced by blood and obviates the necessity of putting in any foreign body such as iodoform or bismuth.

DR. DUDLEY P. ALLEN, of Cleveland: Some years ago I removed the lower jaw of a patient for giant-cell sarcoma, leaving but a small portion of the substance of the jaw. I used a splint to hold the teeth in place. The patient recovered entirely and is now well.

DR. WILLIAM S. HALSTED, of Baltimore: I am reminded of a patient with a myxoma of the humerus; although the disease involved the bone from one end to the other there was no cyst and no fibrous tissue. The bone was excised, excepting for a strip posteriorly and at the lower end, and the entire cavity carefully swabbed out with carbolic acid. The patient made a good recovery and had a strong humerus, but there were implantation recurrences in the soft parts on two occasions. It has now been four years since the first operation and the patient at present is perfectly well.

DR. NATHAN JACOBSON, of Syracuse: In reference to giant-cell sarcoma of the jaw I recall one case still living in whom I did a partial excision of the upper jaw for giant-cell sarcoma about 25 years ago. There was never any recurrence. In my experience in those cases of giant-cell sarcoma where there is reasonable cleaning out there is seldom a recurrence of the growth.

PROFESSOR A. VON EISELSBERG, of Vienna: In such cases as these mentioned by the reader of this paper we are in the habit, before finishing the operation, of pouring boiling water into the wound in order to destroy all the germs, and have found it a most satisfactory method.

DR. JOSEPH C. BLOODGOOD, of Baltimore (in closing): Dr. Halsted's case of exostosis with involvement of the humerus brings out the point that pure myxoma is a benign tumor, that recurrence after operation may be due not so much to leaving a portion of the tumor growth behind as to infecting the wound in removal of the tumor. In such cases it would be well to use boiling water, pure carbolic, or Paquelin's cautery to disinfect the wound.

DIAGNOSIS AND SURGICAL TREATMENT OF ŒSOPHAGEAL DIVERTICULA

DR. CHARLES H. MAYO, of Rochester, Minnesota: Diverticula of the œsophagus were described by Rokitansky in 1840 and classified as *pressure* or *pulsion* sacs, and traction sacs. Most cases are pharyngo-œsophageal, determined by the origin of the diverticulum.

The condition is confined to adults. Dysphagia is the most common symptom; cough and dyspnœa are common. Distended sacs are often visible in the neck and can be emptied by pressure. Condition is disclosed by probing and by radiograph of bismuth distended sac.

H. S. Plummer's method of diagnosis is a combination of the technique of Mixter and Dunham, as used in stricture. The patient swallows a silk thread which passes into the intestine. The Plummer perforated acorn probe passed on the thread gives depth of pocket and location of its neck. By alternating the tension of the thread, elevating the probe to the distal opening of the œsophagus, a pocket and its depth can be ascertained and tubes passed for feeding. Gastrostomy for temporary feeding may be necessary.

Operation is as follows: Lateral oblique incision; blunt dissection; exposure of sac and excision; closure by suture; rubber tissue drain.

There have been 8 cases in the Rochester clinic; six operated upon successfully and two which were not operated upon.

REMOVAL OF A TACK FROM THE LEFT BRONCHUS

DR. N. B. CARSON, of St. Louis: Annie Y., aged 4, came to my service in the St. Louis Mullanphy Hospital, January 18, 1909. All that could be learned was that a month before entering the hospital she was supposed to have swallowed an upholsterer's tack, which was followed by a severe spell of coughing, and later by a very serious illness. Physical examination showed the child to be very pale, anæmic, emaciated, and weak. She swallowed either liquids or solids with difficulty, and coughed almost constantly, with an expectoration of white mucus, and the coughing was accompanied by a very severe pain on the left side of the sternum. The left lung was dull in the middle portion, while the upper and lower portions were more or less resonant.

A skiagraph of the chest showed the tack in the median line with the head down, and the point upwards, the point being lodged in front of the body of the fifth dorsal vertebra. Examination of the sputum was negative as was also von Pirquet's test.

On January 27th tracheotomy was done, and an attempt made by means of the bronchoscope to remove the tack, which failed. On January 29th, a skiagraph located the tack about the beginning of the left bronchus. January 30th, under rectal anæsthesia, a section of about an inch of the seventh rib on the posterior auxiliary line, was removed, and an opening made into a small abscess cavity in the lung, which discharged about an

ounce of yellowish pus. At the same time the brochoscope was re-introduced into the tracheal opening, and the left bronchus was found to be entirely closed. On account of the inability to get permission to operate sooner nothing was done until the 27th of July, when an opening was made in the chest over the sixth rib and about 3 inches of the rib removed, and the pleural cavity opened. The lung was entirely solidified and upon exploring the left bronchus at its entrance into the base of the lung, an abscess cavity was located which when opened discharged about a drachm of fetid pus. The tack was found in this abscess cavity and removed.

At 7:30 of the same evening there was a twitching of the left side of the face, arm, and hand, which was followed by a partial hemiplegia. After this the patient improved steadily until the evening of August 2d, when there was a gush of blood from the nose and mouth which was speedily followed by death. Post-mortem showed that there had been an extensive inflammation involving the entire lung, and the pleura of that side. Between the left bronchus and the pulmonary artery was an abscess cavity in which the tack had been lodged after it had forced its way through the bronchus. A small opening was found in the pulmonary artery as a result of the erosion caused by the head of the tack.

DISCUSSION

Dr. Samuel J. Mixter, of Boston: I have operated upon 3 cases of œsophageal diverticula. Where operation is not done, by the passage of very large bougies or probangs by means of a string guide a sufficient dilatation of the spur can be caused to allow the passage of a sufficient amount of food to keep the patient alive. I have about half a dozen such cases now.

Dr. George W. Crile, of Cleveland: I wish to record two cases of operation for œsophageal diverticula, both of which recovered.

Dr. John B. Murphy, of Chicago: The enucleation of the sacs of diverticula is not a difficult matter in itself, but it leaves a large cavity, and it is difficult to avoid the danger occurring from leakage at the suture, infection from the mouth, and particularly the action of the salivary glands upon the loose connective tissue of the mediastinum. I believe not opening the sac at all is the only safe procedure.

With reference to foreign bodies in the bronchus I think more care should be taken to corroborate the history in such cases, as not infrequently on operation no foreign body is found but some pathological condition which accounts for the symptoms.

Dr. George E. Brewer, of New York: I would call attention to one symptom in œsophageal diverticula which is characteristic, that is, the presence frequently during the day, perhaps every hour or half hour, of an accumulation of thick, tenacious mucus which the patient will regurgitate to get relief. My own experience has been limited to 3 cases and one operation. This patient was a woman 80 years of age who had lost 50 pounds through starvation. She made a perfectly good recovery from the operation.

Dr. De Forest Willard, of Philadelphia: Surgeons should always remember the possibility of enlarged thymus in sudden deaths in young infants under ether. In such cases one is very likely to be misled by the statement that the child has swallowed some foreign body.

Dr. William L. Rodman, of Philadelphia: I believe in cases of foreign bodies in the air passages great risk is incurred in delaying the period of operation, and would urge that all such cases be operated upon immediately upon being seen.

Dr. Nathan Jacobson, of Syracuse: I simply wish to refer to one case of a 15 months' old child who swallowed a bean. By a tracheotomy the bean was gradually removed and the child made a good recovery. Regarding misleading histories, I was called to see a child suffering from complete obstruction of the trachea. I was told he had swallowed a piece of bone. Subsequent history showed, however, that the child had inherited syphilis, and evidently had gradually increasing disturbance, and the history of the swallowing of the foreign body was purely an assumption.

Dr. Albert Vander Veer, of Albany: With reference to œsophageal diverticula I would like to mention two cases, one in a physician who refused to have an instrument passed and who subsequently died of an acute pneumonia; the other occurring in a woman about 50 years of age. In this case it was impossible to get into the stomach with any form of instrument and I therefore did a gastrostomy and the patient made a splendid recovery. She now alternates between tube feeding and the natural method.

In regard to foreign bodies in the bronchi and in the air passages, I wish to urge that the broncho-scope be made the last resort in such cases and only be employed in the hands of experienced and careful men.

Dr. Joseph Ransohoff, of Cincinnati: I had a very interesting case of abscess of the lung living four or five weeks after operation, the result of the inhalation of a peanut shell.

I would like to mention a case of a foreign body in the air passages which was unsuspected. Some

two or three months after doing an intubation for laryngeal croup in a little child, the patient expectorated a small triangular tag such as is used to stiffen the corners of pasteboard boxes; the presence of this foreign body had not been suspected at the time of operation.

DR. N. B. CARSON, of St. Louis (in closing): I cannot too strongly urge the observance of the rule that the bronchoscope should only be used by competent and skillful men. I consider it a dangerous instrument when generally used.

SOME OBSERVATIONS REGARDING THORACIC SURGERY ON HUMAN BEINGS

DR. WILLY MEYER, of New York, has so far operated upon 10 cases with the help of his differential pressure apparatus for affections of the pleura, lung, and esophagus. After discussing the effect of differential pressure, in more rapidly bringing to a close the empyema cavity, as well as its usefulness in the after-treatment, he dwells particularly on the cases of two young patients, 6 and 11 years old respectively, who had suffered for years from bronchiectatic abscess symptoms; both were bad risks. He extirpated a lobe of the lung in each case, but neither recovered.

Three times exploratory thoracotomy was done for cancer of the œsophagus with recovery. In order to do good surgical work when operating for a malignant stricture of the œsophagus, he found it necessary to get the scapula out of the way. He, therefore, proposes as a preliminary operation the Schede-Friedrich flap operation, by which the entire shoulder girdle is turned up, thus permitting the surgeon to make his incision into the thoracic cavity wherever required; often two incisions are necessary. Dr. Meyer prefers the intercostal incision to resection of the rib or ribs. He presented illustrations which demonstrated the procedure.

On March 31, 1910, Dr. Meyer for the first time proceeded in this way for a cancer of the œsophagus in a patient 43 years of age. It was found that the malignant tumor extended from about 1½ inches above the cardia to the aortic arch. After division of the œsophagus and inversion of the lower stump through the 6th intercostal, the 3d interspace was opened, and the healthy portion of œsophagus reached, outside of the common carotid artery, after proper division of the costal pleura; then the entire diseased portion was shelled out and brought in front of the aortic arch. To the operator's dismay it was found in the course of this latter part of the operation that the growth involved the right pneumogastric nerve; it was impossible to push the nerve off; it had to be divided at the lower end of the tumor, and again interfered with in amputating the œsophagus above the upper border of the tumor. The proximal end was also inverted by a double purse-string suture, the intention being to do gastrostomy two or three days later. The interference with the pneumogastric nerve had a deleterious effect upon the heart action, which up to this time had been splendid. The operation was well completed, but in spite of intravenous infusion given, the patient succumbed shortly afterward.

It is pointed out that the only hope of operative success in these cases lies in *early* operation, certainly before the intimately adjacent pneumogastric branches are involved, and the first step of such operation should be to prepare free these nerves. Their involvement will more or less decide the operability or inoperability of the given case.

Additional experimental work is required in order to determine how far we are permitted to divide the pneumogastric of one side of the œsophogus should the growth within the latter have encroached upon the nerve. Involvement of the nerve on either side is an absolute contraindication to going ahead with the operation. Interference with the pneumogastrics during the operation greatly affects the heart's action as well as the respiration. The ordinary stimulants, inclusive of intravenous infusion, are of no avail. Sudden changes in differential pressure, however, have been found of great value. The author briefly discussed how best to carry out in such emergency artificial respiration, which he is able to do also with his differential pressure apparatus.

Up to the present time resection of the œsophagus has a mortality of 100 per cent.

END-TO-END INTESTINAL ANASTOMOSIS BY THE INVAGINATION METHOD

DR. C. L. GIBSON, of New York: End-to-end intestinal anastomosis by telescoping one segment into the other has been practiced from time immemorial, but at present has no recognized position in surgery. As a result of animal experiments and five successful cases the author believes that with his present technique it furnishes a method for which there is a demand particularly in the surgery of the lower end of the colon. The technique is as follows:

The upper cut edge of the gut is seized with two Kocher clamps and introduced by these into the lumen of the lower end and maintained there by an assistant. The extent to which it is feasible to accomplish this invagination will vary. The gut is rotated about a quarter circle so that the non-

peritoneal covered surfaces do not entirely approximate in the circumference. Eight to twelve interrupted silk sutures are introduced thus. A Lembert suture is begun on the lower segment, the needle issuing just short of the cut edge, on the upper segment the needle is introduced just above the line where the cut edge of the lower segment lies against the intact wall of the upper. When the knot is tied the free cut edge has been turned inward, and only the peritoneal surfaces are in contact. A continuous running suture is applied over this area further invaginating the first ones, the Kocher clamps being previously withdrawn.

DISCUSSION

DR. CHARLES H. MAYO, of Rochester, Minn.: I want to testify to the invagination method being a good one in the removal of tumors low in the sigmoid, at the upper rectum; in fact, it is about the only way you can get a union, to invaginate the upper end into the lower.

DR. JOHN B. DEAVER, of Philadelphia: I wish to report the following cases in this regard. The first is as follows: In the early part of last winter an artificial anus caused by ulcerative separation of the lower sigmoid at junction with rectum, due to pressure necrosis consequent upon the presence of an old appendical abscess evacuated through the linea alba some weeks previously. Spencer Wells forceps passed up rectum and sigmoid brought down to anus and stitched to freshened margin of anus. Patient made a good recovery. The second case occurred three weeks ago, being one in which the lower sigmoid was damaged in removal by pan-hysterectomy of a uterine tumor involving the bowel. Patient recovered.

DR. ALBERT J. OCHSNER, of Chicago: If immediately upon the appearance of nausea or gaseous distension gastric lavage be instituted there will be fewer instances of intestinal obstruction, following shortly after operation. As regards intestinal obstruction due to conditions appearing many weeks after operation, our observation has been that we have practically no mortality excepting in those cases coming under our treatment after having received cathartics.

DR. E. WYLLYS ANDREWS, of Chicago: End-to-end anastomosis implies for success that we get our lumen at once, and this is not true with the McGraw ligature; but if we can devise a method by which all the advantages of this ligature can be strengthened by obtaining the open lumen immediately, we will have an ideal method.

DR. ALEXANDER H. FERGUSON, of Chicago: In regard to operative obstruction and the prevention of adhesions following operations, I would say that for four years I have used subgalate of bismuth, smearing it over all raw surfaces, with most complete satisfaction.

DR. ARPAD G. GERSTER, of New York: If we want to make headway against obstructions caused by adhesions we must first know the cause of the adhesions, and this we do not know at present. Many causes have been exploited, the use of packings, the handling of the intestines, and other mostly traumatic lesions to the peritoneal coat, but we have seen in the presence of the greatest traumatism that could be inflicted on the intestine that adhesions did not form. Here the pathologist and experimental surgeon must come to our aid. I believe that the cause must be looked for in certain conditions of the blood of the patient.

ABNORMAL POSITION OF THE DUODENUM

DR. G. E. ARMSTRONG, of Montreal, Canada: The duodenum is singularly constant in its relations, course, and length; and exceptions are exceedingly rare and worthy of note.

In the anomaly reported the duodenum ran to the right and then turned downwards external to the hepatic flexure, ascending colon, and cæcum, and, merging into the jejunum, passed from without inwards below the cæcum into the small intestine area. The duodenum was completely surrounded by peritoneum. It had a long mesentery throughout and could easily be held two or three inches in front of the abdominal wall. The head of the pancreas, closely applied to the duodenum, was visible, and palpable between the layers of the duodenal mesentery, and readily followed the duodenum when the latter was brought outside the body.

Instead, therefore, of passing across the second lumbar vertebra and behind the transverse colon and superior mesenteric artery, it retained an early embryological position. There was of course no ligament of Treitz and no fossa duodeno-jejunalis. The condition is clearly one of arrested development. The cæcum in this case did not mount upwards to the lower hypochondrium and did not pass in front of the loop of the duodenum. The cæcum did not descend to its usual final resting place in the right iliac fossa. It was high, completely surrounded by peritoneum, very movable, and could be brought out through the epigastric incision and held eight inches in front of the body.

DISCUSSION

DR. MAURICE H. RICHARDSON, of Boston: I would report a case in which the appendix, the gall-bladder, the liver, and the ileocæcal valve were

on the left side, the spleen on the right side, and the heart on the right side.

Dr. Emmet Rixford, of San Francisco: I would like to put on record a case of failure of rotation of the primary gut. The explanation of this condition is probably to be explained on the basis of adhesions of the cæcum to the parietal peritoneum the result of a fœtal peritonitis.

Dr. Leonard Freeman, of Denver: I had a case in which acute dilatation of the stomach followed an unimportant pelvic operation, and which at autopsy showed the duodenum passing directly beneath the liver and firmly attached to the posterior abdominal wall and around the right side as far as the hepatic flexure of the colon.

Dr. Joseph A. Blake, of New York: I have met with two cases of abnormal position of the duodenum in my practice. I do not think there is apt to be dilatation in such cases, as the mesenteric vessels do not cross the duodenum, and the duodenum instead of being bound down is usually free.

Dr. Alexander Primrose, of Toronto: I would like to emphasize the fact that these conditions of abnormality in the position of the duodenum may occur without giving rise to the slightest symptoms.

Dr. Joseph C. Bloodgood, of Baltimore: I would like to record one other anomaly of the intestinal tract which I think must be very unusual, namely, absence of the appendix.

REPORT OF A CASE OF HEPATICO-DUODENAL ANASTOMOSIS

Dr. George Emerson Brewer, of New York: The patient was admitted to the Roosevelt Hospital suffering from acute cholecystitis. Following a cholecystectomy there occurred extensive sloughing of the wound, which was followed by a complete biliary fistula. At the end of 75 days as no bile was passing into the bowel, the abdomen was reopened, and the fistula followed down to the common hepatic duct. As no trace of a common duct could be found even after reflecting the duodenum and exposing the head of the pancreas, it was assumed that it had been destroyed by the suppurating process which followed the primary operation. A rubber drainage tube, three inches in length, was introduced into the hepatic duct and also through the duodenum by a stab wound at its upper border, and was secured in these two situations by two purse-string sutures. A mass of omentum was then wrapped around the tube, extending well beyond its introduction in the hepatic duct and duodenum with a view to create a new common duct after the manner suggested by Sullivan. The abdominal wound was closed, a small cigarette drain being allowed to remain at its upper angle. From that time no bile appeared in the wound. The bowels moved on the third day as the result of an enema, and the stools contained an abundance of bile. The reconstructed duct continued to functionate until after the man's discharge from the hospital some four or five weeks after the last operation. Since then he has had two or three attacks of fever associated with jaundice which would disappear in two or three days. At the present time he is still jaundiced, although some bile is present in the stools. Dr. Brewer asked the advice of the members of the Association as to further treatment in case the newly constructed duct became totally occluded.

DISCUSSION

Dr. Alexander H. Ferguson, of Chicago: Since the observation that if all the bile is directed into the hepatic flexure of the large bowel the patient does not suffer from the lack of bile (which observation I believe was first confirmed by Mayo Robson) I have followed this technique in at least half a dozen cases with extremely gratifying results.

Dr. Joseph C. Bloodgood, of Baltimore: I would like to report an anastomosis of small intestine by opening the transverse colon as in posterior gastroenterostomy, sewing a long loop of the small intestine through the transverse colon, and suturing it to the gall-bladder.

RESECTION OF THE PANCREAS, WITH REPORT OF A CASE

Dr. J. M. T. Finney, of Baltimore: The principal object of this communication is to record the successful removal of a primary solid tumor of the pancreas. The operation involved the resection of the entire middle portion of the gland, leaving only a small piece of the head and the tail respectively and necessitating a reunion of these segments by suture. A search of the literature reveals records of but 16 other undoubted cases in which the pancreas has been resected, either in whole or in part, for primary tumor of the gland.

A review was given of the recent advances of surgery of the pancreas due to experimental and clinical work. The difficulties of operating upon the pancreas were referred to and the best methods of avoiding and controlling the same. The best methods of dealing with pancreatic fistulæ were next taken up. The diagnosis of primary solid tumors of the pancreas is made usually by exclusion, and it is not always possible beforehand. Different routes for attacking pancreatic tumors

were discussed and the various operations which had been suggested were described. These were so difficult and dangerous as to prevent their general use.

The statistics of the operation for primary tumor of the pancreas were given. Of the 17 cases, 12 occurred in females and 3 in males. Carcinoma occurred 10 times, sarcoma 4, fibroadenoma 2, cystic adenoma once. Of the 17 cases, 9 recovered and 8 died. In two instances the pancreas has been reported as having been removed in toto. Three times the gland was completely divided into two parts and the remaining portion sutured. All three recovered.

DISCUSSION

Dr. M. L. Harris, of Chicago: I would like to mention a case of a policeman shot by a 38-caliber bullet which entered just below the 12th rib on the left side and was found just beneath the skin a little to the right of the median line between the 8th and 9th ribs. The track of the bullet from before backward was through the right lobe of the liver, the lesser curvature of the stomach, the middle of the pancreas, practically bisecting the organ, and the left kidney. The stomach was sewed up, then the pancreas, and as close an approximation of parts made as possible. Drainage front and back. Fistula resulted but closed in about three months and patient fully recovered.

Dr. G. E. Armstrong, of Montreal: With regard to the mobility of pancreatic tumors I would like to mention a case in which there was a large pancreatic cyst which for a long time, because of its mobility, was considered to be a growth in the stomach.

Dr. Willy Meyer, of New York: I have had two cases in which the tail of the pancreas was tightly adherent to the existing tumor, and here I put a piece of chromicized gut around it and divided the distal end with the Paquelin cautery. Both patients recovered.

Dr. Rudolph Matas, of New Orleans: I wish to report an additional case of unusual character, thrombosis of the splenic artery incidentally involving the pancreatic arterial supply, causing degeneration of the organ from the head to the tail, associated with multiple tumor formation in the spleen. The spleen and three-quarters of the pancreas were removed and the patient recovered from the operation, dying about three years later from a slow fever.

CONGESTION OF THE LOWER LOBE OF THE RIGHT LUNG AN EARLY SYMPTOM IN APPENDICITIS

Dr. John B. Roberts, of Philadelphia: The author suggested the possibility of a secondary congestion of the lower part of the right lung being found in a considerable number of cases of acute appendicitis. He spoke of this condition being a possible aid in the diagnosis of acute appendicitis when the symptoms of the latter were not yet very definite. A point was made that this observation did not refer to secondary pleuritis and pulmonary involvement occurring in the late stages of appendicitis. Such inflammation from septic invasion secondary to advanced appendicitis was an entirely different process. The idea of the author evidently was that appendicitis and perhaps other intra-abdominal inflammations, might cause atelectasis of the right lung, or a true congestion, because of the insufficient action of the diaphragm upon the right side. This spasm or immobility of the right side of the diaphragm he compared with the tonic spasm of the muscles overlying the appendix in the front of the abdominal wall. It was, however, also suggested that the engorgement of the base of the right lung in cases of appendicitis might be due to a simultaneous infection of both the appendix and the lung by the pneumococcus or other invading organism. The well known fact that pneumonia is sometimes accompanied by pain and muscular rigidity in the right iliac fossa was mentioned, as was also the clinical observation that acute appendicitis may in its early stages give rise to pain in the right lower thoracic region. The early congestion of the right lung, which Dr. Roberts thinks he has found in the early or initiatory stages of appendicitis, might also occur from inflammation of the gall-bladder or cellulitis around the upper pole of the kidney. The paper referred to somewhat similar observations by other writers, which seemed to at least partially confirm the correctness of the value of this new point in the diagnosis of appendicitis.

VACCINE THERAPY AS AN ADJUNCT TO SURGERY

Dr. John B. Deaver, Dr. John C. DaCosta, Jr., and Dr. D. B. Pfeiffer, of Philadelphia: There has been established at the German Hospital a special department of vaccine therapy. In addition to its well known and satisfactory use in suppurative affections of the skin and other forms of minor chronic infection, this form of treatment has been used as an adjunct in the treatment of more severe surgical infective conditions.

Vaccines did not prove of service in three cases of streptococcic septicæma in which the treatment was begun late. Four cases of severe staphylococcic septicæmia recovered, improvement in each case beginning with the initiation of the vaccine treatment. Eight cases of severe septic intoxication without demonstrated bacteræmia were treated

by drainage and vaccines. Two were in extremis when treatment was begun and died shortly afterwards. The remainder recovered. Five of the cases were streptococcic infections.

Improvement was also noted in a miscellaneous group of cases comprising persistent sinuses, cystitis, thrombosis, etc. Not all cases, however, gave a definite response. The dosage varied from 25,000,000 to 750,000,000. The sicker the patient and the less satisfactory the response, the smaller and less frequent should be the dose. Streptococcus also was used in smaller dosage than staphylococcus.

On the basis of these results the paper concludes:

Specific vaccine treatment in our hands has not proved of benefit in the later stages of streptococcic septicæmia.

Staphylococcic septicæmia has been treated with most favorable results at all stages.

Septic intoxications without demonstrated blood invasion in a majority of the cases display general and local improvement under the use of vaccines if given early; the later the treatment, the less certain and satisfactory the result.

Localized and persistent suppurating lesions are sometimes markedly benefited by vaccines.

Surgical procedures for the relief of infectious conditions should be reinforced by vaccine treatment which should be begun as early as is consistent with the case, and preferably by autogenous organisms.

No hospital can be considered fully equipped which is not prepared to supply this form of treatment in conjunction with established measures.

This paper will appear in full in a later issue of SURGERY, GYNECOLOGY AND OBSTETRICS.

THERAPY BY BACTERINS AND TUBERCULINS IN MIXED SUPPURATIVE BONE AND JOINT DISEASE

DR. DE FOREST WILLARD, and DR. B. A. THOMAS, of Philadelphia: The authors recount their experience of two years' duration in the treatment by bacterins and tuberculins of tuberculous bone and joint disease, complicated by mixed pyogenic infections. The feature of the treatment consists in the alternation of bacterin and tuberculin inoculations in the mixed suppurative type of the disease, as spinal caries, tuberculous hip-joint disease, etc. They do not contend that bacterin therapy is a "cure-all," nor that when indications for surgical intervention exist, they can be disregarded and active immunization substituted. They wish, however, to emphasize the fact that the *accessory* employment of bacterin and tuberculin in certain cases stimulates the tissue cells of the organism to the production of specific antibodies to assist the bodily defenses in antagonizing and combating the given infections. On the other hand, the incompetent, inexperienced, and careless use of these measures will not only fail to effect cure but will inevitably lead to disaster and thrust a therapeutic measure of worth into disrepute. Bacterins, particularly tuberculin, are more potent agents for evil than for good, unless wisely administered. They are invaluable aids in competent hands and when so employed these cases do better with than those treated without bacterins; their detention in the hospital is shortened, and complications, if they occur, are fewer and less severe.

The authors present two definite clinical types of disease illustrated by charts, in which therapy by bacterins and tuberculins is recommended. The first type is represented by the case in which already at the time of operation a mixed infection of hæmatogenous or exogenous origin has been superimposed upon suppurative tuberculous caries. The second type is manifested in the evacuation and drainage of a "cold abscess" in which case almost invariably after a lapse of 15 to 20 days, the temperature suddenly rises and symptoms of a mixed infection ensue.

These types of disease are of a serious character, not those mild cases which would recover following simple incision and evacuation, nor those neglected ones of prolonged suppuration, characterized by bacteræmia, grave saprœmia and amyloid disease, but those with chronic localized processes, the treatment and prognosis of which have been greatly handicapped by the intervention of various pyogenic bacteria.

The authors have found that in the course of weeks the various pathogenic bacteria isolated from the suppuration vary, and for that reason they insist upon the employment of autogenous bacterins, the pus being cultured and recultured at least monthly. As soon as the patient's temperature falls to 100 degrees or preferably lower, under the administration of bacterins, inoculations with tuberculins, either alone or alternating with bacterins for a time, are begun. They conclude, judging from the cases under their observation, that better results have attended the process of active immunization, when, just as in tuberculin therapy, pure and simple, the treatment has been commenced with relatively small bacterial inoculations, progressively increased to the therapeutic limit, rather than by recourse to large dosage, thereby in the former case establishing immunity, and in the latter avoiding anaphylaxis.

Studious observations of the clinical symptoma-

tology have always sufficed to control the treatment, the opsonic index proving not only impractical but unreliable.

DISCUSSION

Dr. J. M. T. Finney, of Baltimore: In regard to the use of vaccines in chronic infections of the bladder from the colon bacillus, I would mention a case in which, after every other method had failed, injections were followed by the most astonishing results, the bladder symptoms all practically disappearing.

Dr. Willis G. MacDonald, of Albany: I would like to call attention to the extreme importance of not giving too large a dose of vaccines, as I have found this regulation of the dosage very troublesome in those cases in my experience.

Surgeon-General Sternberg, of Washington: It is impossible to doubt that vaccine treatment is beneficial in a certain class of cases, but it is difficult to understand why it should be. You have a certain specific micro-organism in the blood in large numbers, producing toxic products, and why the introduction of a comparatively small number of the same micro-organisms under the skin should have such a potent effect in arresting the progress of the disease is to me inexplicable.

Dr. L. L. McArthur, of Chicago: I want to call attention to the tuberculin treatment in essential hæmorrhage of the kidney. Treatment with the autogenous vaccine of the colon bacillus in several such cases has been productive of a cure, and I consider this a most beneficial treatment in this condition.

Dr. John B. Murphy, of Chicago: The essential hæmorrhage of the kidney, the essential hæmorrhage of the uterus occurring in girls under 20 with tuberculous histories, respond marvelously to proper dosage with tuberculin. Great assistance is rendered by this treatment in cases of bone tuberculosis. There is, however, no more treacherous and dangerous a drug than tuberculin if improperly given. As a stimulant, and as an aid to surgical tuberculosis, I know of nothing so good when the treatment is carefully administered.

Dr. Joseph C. Bloodgood, of Baltimore: I have had no experience in the vaccine treatment but would like to suggest in regard to the essential hæmorrhage of the kidney that a more simple serum be tried first. The professor of pathology at Tufts College has demonstrated the rapidity with which blood serum of all animals will check hæmorrhage, so perhaps it is some antibody in the serum and not the organism that checks the hæmorrhage when tuberculin is used in these cases.

Dr. Joseph A. Blake, of New York: I have been employing the vaccine treatment pretty persistently and in chronic infections have found the autogenous vaccines of great benefit.

Dr. Arthur Dean Bevan, of Chicago: From my limited knowledge I would consider it too early at this time to arrive at any definite conclusions with regard to the value of this treatment. I have been particularly interested in the application of the vaccine treatment to tuberculosis of the kidney and mixed infection of tuberculosis of the colon, and although I know of cases which under good management with this treatment have gone on to recovery, I also know of cases which without the vaccine treatment also recovered.

Dr. Francis B. Harrington, of Boston: I have seen some cases in which autogenous vaccines have been of great benefit, and also some cases in which they were productive of great harm.

Dr. Harry M. Sherman, of San Francisco: We are using tuberculin more and more in the Children's Hospital. With regard to the vaccine treatment we have had no success with the streptococcus infection.

Dr. Emmet Rixford, of San Francisco: I would like to mention a case of tuberculous anal fistula, tuberculosis of the spinal cord, and tuberculosis of the wrist, which under treatment with tuberculin was completely restored to health. It has been two years since the treatment, there is now no sign of tuberculosis, and the patient has gained 40 pounds in weight.

Dr. James E. Moore, of Minneapolis: I have been disappointed in the serums for the treatment of acute infections. In tubercular cases I have had better results. It is very essential that these treatments should be carried out only by those who know how to use them.

Dr. Charles A. Powers, of Denver: In chronic infections, especially the chronic staphylococcic infections, the autogenous vaccines have not given me the encouraging results which many others have obtained, and I therefore attribute this to faulty methods.

Dr. Charles H. Mayo, of Rochester, Minn.: In regard to the vaccine treatment I would say that I have had very little experience with it, but I have had one case of colon infection of the bladder and kidney in which the autogenous vaccine has proved of benefit.

Dr. John B. Deaver, of Philadelphia (in closing): The toxin treatment is most satisfactory if used judiciously. Like all good surgical measures, it must be instituted early to obtain the best result. The dosage is most important and should be carefully studied and regulated to the individual case.

Dr. De Forest Willard, of Philadelphia (in closing): There are four things to remember in the

use of tuberculin. First, tuberculin is a potent agent for evil as well as for good. It must be used carefully and in careful hands. Second, if a stock vaccine is used by incompetent men the treatment will have disastrous results. Third, the dose must be exceedingly small, for the smaller the dose and the longer time consumed in the treatment, the more certain the beneficial results. Fourth, it is by no means a substitute for surgical procedures.

THE STUDY OF THE ETIOLOGY OF CANCER BASED ON CLINICAL STATISTICS

DR. ISAAC LEVIN, of New York: The investigations are based upon a clinical study of 4,000 cases of carcinoma and sarcoma collected from several large hospitals in the country, the analysis of which showed many results of interest. The greater frequency of the disease in women is due to the prevalence of cancer of the uterus and the female breast. The other organs become affected more frequently in men, which fact may be due only to the greater subjection of the latter sex to the different injurious influences of civilized life. Cancer, while considered to be a disease of an advanced age, appears, according to this investigation, to occur in many instances in people who have not yet reached middle age. Child-bearing does not seem to have any direct connection to the causation of cancer. Another point of interest is the fact that American Indians rarely contract the disease. The data on the influence of occupation in the etiology of the disease were very defective, and no conclusion could be derived from them. It is expected that with the co-operation of the profession better results will be obtained in this connection in the future work. The presence of a preceding local disease in the organ affected with cancer, while of certain importance, cannot be considered as the main etiological factor. Hereditary disposition does not seem to have an influence upon the causation of the disease sufficient to warrant the great dread of the lay public before this hereditary trait.

In conclusion, the statement may be made that while this investigation cannot claim to have reached any final result in the elucidation of the etiology of cancer, it appears evident that a local trauma or previous disease of the affected organ is of less importance in the causation of cancer than the increased vulnerability and lessened resistance of the organism caused by the ever-increasing strain of the modern life. This is certainly the only explanation that may be offered for the increasing frequency of the occurrence of cancer in civilized communities. That this increase is not only apparent is very evident from the mortality statistics of the United States in 1907, which show a ratio of 73.1 deaths from cancer per 100,000 population, as compared with the ratio of 70.8 in 1906.

It is expected that this statistical cancer research, which is still being continued, may arouse an interest in the matter in the members of the profession, who are requested to fill out the schedules which may be obtained on demand and offered free examination of tumor tissue.

DISCUSSION

DR. CHARLES A. POWERS, of Denver: I want to call attention to the formerly prevalent idea that youth was a bar to carcinoma. During the past year I have had no less than three patients under twenty-four years of age suffering from epithelioma.

ON THE SIMULATION OF NEOPLASMS BY INFLAMMATORY PROCESSES

DR. C. A. HAMANN, of Cleveland: The resemblance, clinically, between certain inflammatory processes and tumors, leads to errors in diagnosis.

Chronic osteomyelitis and other forms of bone disease resulting in enlargement of bones; formative osteitis, as the result of various irritants, leads to the production of swellings which simulate neoplasms. Methods of differentiation. Myositis ossificans, circumscribed enlargements of muscles, myositis fibrosa.

Inflammatory thickening around foreign bodies in abdominal wall ("ligature and foreign body tumors"), inflammation of the omentum after ligation of portions of it.

Pseudoneoplasms of stomach. Inflammatory pseudoneoplasms of intestines; periappendicular swellings; diverticulitis, associated with the formation of connective tissue masses; tumors of the rectum and perirectal tissues, inflammatory in origin. So called disappearing tumors are in many instances inflammatory pseudoneoplasms.

Chronic mastitis in some of its various forms.

DISCUSSION

DR. HARRY M. SHERMAN, of San Francisco: I would like to report an instance in which I, through a mistaken diagnosis, removed an inflammatory mass believing it to be sarcoma, including the parotid gland. A radical operation was done, beginning with the clavicle, with removal of all the tissues up to and including the parotid gland, following the report on a section of the growth sent to the pathologist that it was probably of sarcomatous origin. When the whole mass was sent to the laboratory for examination, however, it was

proven to be an inflammatory mass in the center of which was a normal parotid gland. In the light, however, of no clinical symptoms of syphilis and a negative Wassermann, and a definite tumor mass, the evidence against syphilis in the diagnosis was enough to justify the operation for sarcoma.

A REVIEW OF ONE HUNDRED AND TWENTY RESECTIONS OF THE RECTUM FOR CANCER

DR. WILLIAM J. MAYO, of Rochester, Minnesota: Total number of resections of the rectum for cancer, in St. Mary's Hospital, from April 21, 1907, to December 31, 1909 120

Males	63	
Females	57	
Age of oldest	81	
Age of youngest	27	
Average age	52.12	
Perineal route —		
Perineal resection	11	
Quenu-Tuttle	22	
Harrison-Cripps	5	38
Posterior route —		
Kraske: Modified	51	
Resection continuity	5	56
Abdominal combined —		
Combined	20	
Combined with permanent colostomy	6	26

Operative mortality. This includes all cases dying in the hospital following operation without regard to cause or length of time. Three deaths occurred from exhaustion more than four weeks after operation, one from pulmonary embolus, and one from apoplexy.

Total number	120
Mortality	20.16%
Total number during 1908–09	44
Mortality	4.9 %

Amount of bowel removed—		
Lower rectum	5	
Middle rectum	5	
Entire rectum	75	
Entire rectum and part of sigmoid	32	
Entire rectum, part of sigmoid, uterus, ovaries, tubes, part of vagina	1	
Rectum and prostate	2	
Total	120	

Pathologist's report—		
Carcinoma	119	
Sarcoma	1	
Total	120	
Operated upon more than 5 years ago	32	
Present condition known	17	
Alive and well—		
2 abdominal (1 over 9¾ yrs., 1 over 5 yrs.)		
2 perineal (1 over 9 yrs., 1 over 7¾ yrs.)	4	
Operated more than 4 yrs. ago	41	
Present condition known	26	
Alive and well (4 abdominal, 3 perineal, 6 posterior)	13	
Operated upon more than 2 yrs. ago	82	
Present condition known	63	
Alive and well	26	
Operated upon more than 1 yr. ago	102	
Present condition known	82	
Alive and well	36	
Operation less than 1 yr. ago	18	

DISCUSSION

DR. ARTHUR DEAN BEVAN, of Chicago: There is a point of technique I wish to emphasize after an experience with some 20 cases in which the Kraske operation was performed. That is, during the Kraske operation we do not employ a single ligature, but simply as we come to the tissues on the sides of the incision freeing the rectum, massive 10″ or 12″ clamps are put on the tissues, for instance, high up on the levator ani muscles and on the inferior hæmorrhoidal vessels which supply the rectum and the lower part of the sigmoid. With the employment of these clamps there is less risk of hæmorrhage and a greater saving of time than if an attempt is made at ligation.

DR. JOSEPH C. BLOODGOOD, of Baltimore: One of my first cases, operated on about six years ago, was such that we were able to save 3 inches of the anus and rectum, making a suture of the sigmoid which was brought down, and this patient has not only been as well as before, but has perfect function.

DR. ALEXANDER H. FERGUSON, of Chicago: In some of these cases I have resorted to the combined operation in two stages to advantage. Open the abdomen, take the proximal end of the bowel, make an artificial anus, invert the distal end into the rectum — that would be one operation; then, when the patient is in good condition, remove the rectum from below, the bowel being already inverted giving ready access to the mass. By the use of clamps without ligatures the operation can be done in a few minutes.

DR. JOSEPH A. BLAKE, of New York: I have had more experience with the combined operation than with any other; I have done 12 consecutive operations in that way without any mortality. The mortality is less if a permanent colostomy is done; it avoids infection and the operative field is kept comparatively clean, and it also affords the opportunity of removing the whole growth at the

lower part of the bowel. This procedure should be confined to those cases at the middle of the rectum or above, and those in which the anal sphincter is involved and has to be removed.

DR. G. E. ARMSTRONG, of Montreal: In the low cases where the sphincter has been involved I have sometimes succeeded in getting a satisfactory sphincter by bringing the upper ends down through the lower fibers of the gluteus maximus. One such case operated upon ten years ago now has perfect control.

DR. WILLIAM J. MAYO, of Rochester, Minn. (in closing): We have some very satisfactory cases of union between the sigmoid and lower portion of the rectum, and the rule has been, when made from above it has been all right, but when made through the posterior incision, or through the vagina, there is ulcer and fistula. In regard to permanent colostomy, I have often regretted not employing this procedure, because some of our deaths have been due to infection.

I wish to emphasize the point that it is practically impossible to make honest percentages of cases such as these, for the reason that if all cases which cannot be traced are counted as dead the mortality rate would mount up. This is the only way, however, to consider such cases of which we have no absolute record, and proves the inaccuracy of any percentages which we may try to strike.

CHORIOCARCINOMA: REPORT OF A CASE OCCURRING IN A PATIENT WITH AN INFANTILE UTERUS

DR. A. PRIMROSE, of Toronto, Canada: Tumors variously described in individual instances as chorioepithelioma, deciduoma malignum, syncytioma maligna, etc., have hitherto been considered as overgrowths of chorionic villi which invade the blood sinuses of the uterine wall, and then rapidly disseminating, present the clinical picture of great malignancy.

A neoplastic growth of this character may occur after normal pregnancy. In addition, however, it may follow miscarriage or it may make its appearance after the removal of a vesicular mole. In cases of ectopic gestation the tumor elements have been demonstrated in the gestation sac. In 1903 Teacher published the results of an exhaustive study of chorioepitheliomata and his views have generally been accepted that they arise in connection with pregnancy and originate from the chorionic epithelium which is of fœtal epiblastic origin.

The tumor removed presented the characteristic elements of a choriocarcinoma with a very large proportion of Langhans' cells showing metaplasia and mitosis. A few isolated masses of the syncytium were also present.

These tumors may exhibit a histological structure in which fully formed villi may be present or the cellular elements of that structure in varying proportion. Secondary growths are common in the vagina or in the lungs, but occasionally metastases occur in the liver, kidney, and other organs. There is a relationship between pathological processes resulting in a neoplasm and physiological activity because the invasion of the maternal uterine tissues of the villi occurs as a normal process in pregnancy. Increased activity in this direction may lead to malignant infiltration and tumor formation. A further fact of interest is that in normal pregnancy normal chorionic elements are carried to the lungs and lodged in the pulmonary capillaries and there undergo absorption.

The clinical course of chorioma presents great variation. The primary growth may disappear spontaneously and this may occur whilst secondary metastases continue and produce a fatal issue. Hæmorrhage, pain, anæmia, and extreme emaciation are frequent symptoms and where metastases occur in the lungs then we have cough and hæmoptysis.

Ewing's classification is the most valuable guide for prognosis and treatment.

Chorioadenoma in which the structure of the villus with its normal histological arrangement is reproduced.

Choriocarcinoma in which Langhans' cells are chiefly in evidence and where marked mitosis is observed.

Syncytial endometritis where the maternal tissues are invaded with wandering cells derived from the syncytium.

Syncytioma where transitional types are in evidence.

Of these the choriocarcinoma is extremely malignant and is probably invariably fatal. The other forms present great variation in their degree of malignancy and may even disappear spontaneously or after partial removal.

Where spontaneous disappearance does occur Teacher has shown that the process is brought about by fibrosis and encapsulation.

PROGNOSIS AND OPERATIVE TREATMENT OF FRACTURE OF THE BASE OF THE SKULL

DR. JOSEPH RANSOHOFF, of Cincinnati: The paper was based on an analysis of 190 cases occurring during the last ten years in the Cincinnati Hospital. One hundred and twenty-four of the cases were fatal. The prognosis is influenced by the depth of the coma chiefly and even in greater degree by the fixed condition of the pupils. Of 42 patients with non-reacting pupils, 41 died. In

5 years there were 19 operations, trephining or decompressive, with 7 recoveries. The conclusions of the paper were as follows:

1. There will always be a large mortality connected with basal fractures; death resulting from primary shock, brain laceration, or hæmorrhage. Thirty-seven per cent of the fatal cases die within 6 hours or less, and 56 per cent die within 12 hours. It is not probable that the mortality of this class of cases can ever be reduced with or without operation. They are primarily fatal.

2. Twenty-three per cent of the fatal cases die during the second 12 hours of the first day; and 6 per cent die during the second day. They are the cases in which the coma is not profound, in which the pupils are not fixed, in which the breathing is not stertorous, and in which there is not complete muscular relaxation. With a slow full pulse and lumbar puncture indicating hæmorrhage and increase of intracranial pressure, a trephining operation is indicated. In the doubtful cases an operation is indicated.

3. In this class of cases, where facilities for the major operation of trephining are not at hand, repeated lumbar puncture should be essayed. This procedure may be destined to take the place of decompressive operations.

4. There is a large group of cases in which there is complete consciousness or in which there is a somnolence or milder degree of coma; and in whom the concomitant symptoms do not indicate a grave intracranial trauma either to the brain or its vessels. The pupils, though uneven, react; involvement of one or more cranial nerves may be evident. The symptoms singly or collectively are not ominous at any time. Eighty per cent of this class of cases have a tendency to get well with or without operation. They should not be operated on unless the symptoms indicate an increase of intracranial pressure from hæmorrhage, beginning cerebral œdema, or distinct localizing (cortical) symptoms.

5. There is a distinct class of cases in which operation is indicated. They are cases which seemingly not severe in the beginning grow progressively or suddenly worse, showing signs of increased intracranial pressure. Decompressive operations may save a considerable proportion of them.

6. It has yet to be determined where the trephining should be done to obtain the best results. Since most fractures involve the anterior or the middle fossa, subtemporal trephining is doubtless the procedure oftenest indicated. When, however, a hæmatoma in the mastoid or occipital region indicates an involvement of the posterior fossa, the operation should be subtentorial. To relieve the subtentorial tension by an opening made in the temporal region is illogical and may be dangerous. I attempted it recently in a cerebellar tumor, the site of which could not be determined. The patient succumbed within two weeks with symptoms of bulbar paralysis.

DISCUSSION

DR. FRANK E. BUNTS, of Cleveland: In an ordinary case of fracture of the base of the skull in which the blood pressure can be obtained, a beginning choked disk and œdema, and hæmorrhage in the brain detected, the decompression operation should be performed, and in many such cases we may expect altogether beneficial results.

DR. JOSEPH C. BLOODGOOD, of Baltimore: Up to the present time I have been unable to find any case of epilepsy following an injury to the skull in which some piece of the skull was removed, either by operation or by the injury itself. This would rather substantiate the view that epilepsy is more apt to be started up by changes in pressure than by actual injury.

DR. G. E. ARMSTRONG, of Montreal: If in these cases the pressure is subtentorial, as indicated by the respiration, aspiration of the cerebrospinal canal may prove very injurious.

Regarding Dr. Bloodgood's remarks I would like to report two instances where epilepsy has followed in the presence of considerable defect in the skull; one following the kick of a horse in a young man, where there was rupture of membrane, loss of brain tissue with considerable defect in the skull remaining, and epilepsy beginning a couple of years later; the other, in a man injured in the frontal region in which there is a considerable defect in the skull, and epilepsy has followed.

A METHOD OF OVERCOMING THE SHORTENING IN OLD FRACTURES TREATED BY THE OPEN METHOD

DR. EDWARD MARTIN, of Philadelphia: It was because of the complete futility of any method of traction which could be applied to the leg and foot in the case of a ununited fracture of the femur with 2½ inches of shortening that the present method of overcoming the shortening was devised. It consists in a long, strong canvas strip pocketed in the middle and looped at the ends. The bones at the seat of fracture are freed, the pocket is slipped over the proximal end of the distal fragment, the ends of the canvas strip are carried in the long axis of the limb, and in the loops is fixed a cord to which are attached the weights. By thumb pressure the bone is kept from angling out of the wound, and weights up to 100 pounds, or

even more, are attached to the rope. In from three to five minutes the shortening is overcome. Only those structures which interfere with proper placement are stretched, and this is done so thoroughly that there is but slight tendency to the reproduction of deformity.

DISCUSSION

Dr. Richard H. Harte, of Philadelphia: In regard to extension I consider a pulley similar to that used on boats, a double and single pulley, to be the best type to use. These should not be close together, but enough line between them to allow of manipulation of the limb by the operator. After a thorough incision has been made and the ends of the bone exposed, you can disengage the bands of tissue by the employment of steel elevators. It is important to do as little damage as possible to the tissues. I do not consider silver plates strong enough to hold the bones in position and therefore would always advise the use of a heavy steel plate such as that suggested by Lane.

Dr. Albert J. Ochsner, of Chicago: I would like to describe a method which we use almost entirely. It consists in the slow stretching of the muscles, instead of the rapid stretching, and the only thing that is peculiar about the method is the application of rubber adhesive strips to as high a point above the seat of fracture as is possible. For instance, instead of applying the rubber adhesive up to the fracture, it should be applied over the entire length of the thigh, then, with no more than 24 pounds of weight, we have, in every fracture where there has not been a union, been able to stretch the muscles sufficiently to replace the fractures without making a resection of the ends. In cases where there is a union in malposition, the muscles will stretch to a marked extent. It is important to use two Lane plates, with two screws at each end in order to keep the bones from slipping.

Dr. James E. Thompson, of Galveston: I think the important point is that it is not the contraction of the muscles which prevents reduction, it is hæmorrhage, and after this blood clot has been evacuated the bones can be held in proper position.

Dr. Harry M. Sherman, of San Francisco: The method of extension described by Dr. Harte I do not consider as good as where two hanks of yarn are applied as perineal straps, the weight coming on the tuberosity of the ischium. On the foot is put another hank of yarn. The pulling upon the bones has been measured, and over 200 pounds of weight have been applied in some cases without injury to the ligaments of the ankle or knee, and that is sufficient to pull out any tissue interfering with the approximation of the bones.

Dr. Edward Martin, of Philadelphia (in closing): The length of the screws used in adjusting these plates should be the thickness of the bone, should be threaded up to their heads, and to hold the plate in place it is required that they penetrate entirely through the bone and no more.

In cases of extension we prefer to use the old-fashioned resin plaster, properly made, because the rubber plaster always excoriates the skin.

FRACTURE DISLOCATIONS OF THE OS INNOMINATUM

Dr. Harry M. Sherman, of San Francisco: The paper made the point that simple uncomplicated fractures of the pelvic bodies was not of necessity a serious lesion, but that healing could be expected in an ordinary way as after a fracture of a bone of an extremity; that the really serious lesion was the complication of injuries to the bladder, the intestines or the vascular system; that injuries to the bladder were more likely to occur when the fracture had been due to anteroposterior compressive force; that injuries to the urethra were more apt to occur when the fracture was due to transverse compressive force; that the present indications were to open at once the space of Retzius and make a reverse catheterization and perineal section with lateral incisions in the groin and perineum for drainage of all areolar planes. With this technique the mortality should be reduced to about 33 per cent, as against 60 per cent.

DISCUSSION

Dr. Arpad G. Gerster, of New York: I have in my experience a case of fracture of the female pelvis on the left side in which there was no injury of the urethra, although it was compressed to such an extent by a solid blood clot that retention followed and had to be relieved for 15 or 16 days by the use of the catheter. The woman recovered, there was no other injury present. Another case was one in which there was fatal hæmorrhage following fracture of the pelvis. Post-mortem revealed extensive laceration of one of the common iliac arteries and subperitoneal hæmorrhage.

ON MOMBURG'S METHOD OF ARTIFICIAL ANÆMIA BY SUPRAPELVIC CONSTRICTION

Dr. Arpad G. Gerster, of New York: In reporting a successful case of his own, the author presented the history and present status of the method of obtaining artificial anæmia of the pelvis, its organs, and of the lower extremities by the elastic constriction of the abdominal aorta.

CHICAGO SURGICAL SOCIETY

REGULAR MEETING HELD APRIL 8, 1910, WITH DR. ARTHUR DEAN BEVAN, PRESIDENT, IN THE CHAIR

DR. E. WYLLYS ANDREWS, read a paper entitled "Laparotomies upon the Knee-joint for Fractured Patella, and a New Method of After-treatment."

DISCUSSION

DR. WILLIAM E. SCHROEDER: I have had occasion to show a number of cases at different times after wiring the patella. I think the method proposed by Dr. Andrews is unique. He is to be complimented on the excellent results he has obtained. Since we have gotten rid of the wire idea it is marvelous to see how we can invade the knee-joint under antiseptic precautions, rather than follow the detailed method of any one man, for the reason that first, sometimes the superficial fascia is not torn. The last case I operated on, several weeks ago, was a case of that kind, the patient having a fracture of the patella. That was a revelation to me because I had supposed that the fascia was always torn, but it was not. At other times when one gets into the joint he finds conditions much worse than anticipated. Shreds of fascia hang between the two fragments; the knee-joint is full of blood, and sometimes the tears in the transverse and lateral ligaments are extensive. At other times, they are not. Treatment of the joint should be undertaken according to the extent of the injury. I have never had a single bad result from suturing the tendon. I shall be very glad to try the method outlined by Dr. Andrews, because it is simple and along the right lines. I merely wish to say this, however, in defense of other methods, that suturing the quadriceps tendon and patellar ligament with a circular suture of silk or kangaroo tendon will answer the purpose. It can be accomplished in a few minutes with needle or with bone drill with a hole in it, and with the supplementary sutures, as advocated by Blake years ago, through the lateral ligament. This would be sufficient to accomplish the object in view. I have made it a rule to cut off the shreds that Dr. Andrews mentioned, but possibly it may be better to leave them there, but the reason I mention this is because my results have been uniformly good. It was stated some time ago that we should wait for a definite period until the knee-joint develops immunity. The immunity bug got into us for a while. I have operated on fractures of the patella at sight, in some cases in nine days, in other cases two days, and in other instances, within a few hours, and have had over forty-five cases without a single bad result. The suggestion to use massage and early passive motion I approve of very decidedly. I think we have been keeping these joints immobilized too long.

DR. CHARLES DAVISON: I do not think the method of suturing is the principal thing in Dr. Andrews' paper, but the after-treatment. We have all been suturing in a manner similar to that he has described, but most of us have confined these joints for some time afterwards. I have confined the knee-joint until the superficial wound has healed, and have had a certain amount of trouble in getting free movement but much less than under the old method of long fixation. Restoration of function is the prime object of treatment. If by starting passive motion from the beginning we can save any ankylosis, then it is a great advance in the surgery of these parts. Even fixation for two weeks does produce a certain amount of ankylosis, and a certain proportion of cases get into the habit of refracturing the patella. When we get pretty good motion, these patients fall and refracture the patella, not in the same line perhaps, but in a different place, showing it is not a lack of good union, but of poor protection of the joint by lack of good, free motion.

I think the after-treatment that has been described is a decided advantage,—it is perfectly feasible, and I shall try it in my next case.

DR. ARTHUR DEAN BEVAN: To my mind Dr. Andrews' work is very important. I have never employed his method of application in any case, but it impresses me as being scientific and rational, and I am quite sure that we have a good precedent for such treatment.

I was very much impressed by the report of Kummell at Budapest this summer of his last one thousand cases of laparotomy, in which he had tried a very different proposition from the ordinary methods which he had pursued before, in that he got his patient up and about and put strain upon the tissues after the laparotomy incision was closed very early. He made a careful study of this last thousand cases in which this strain had been placed upon the sutures and tissues, as compared with his previous one thousand cases. He found not only that he had fewer complications in a

general way in the way of pneumonias, as one might hope for, and cases of pulmonary embolism and thrombosis, but he found by careful analysis he had much better wound repair; that the wound repair was stronger; that it was more complete, and that it was complete at an earlier date. That it was followed by fewer hernias than in cases where no strain and no tension was put upon the sutures at an early date.

I think Dr. Andrews' choice of the word "laparotomy" when he makes this comparison in considering his after-treatment is a very fortunate one. I am rather inclined to think that the work will be generally followed out. I saw one or two of Dr. Andrews' cases, and I have been very favorably impressed with them.

There is one item of technique to which my attention has been called, and which is very well shown in the X-ray which Dr. Andrews exhibits. I find in a number of these cases where I employed the suturing of fibrous structures I had a little wedge-shaped space between the fragments, which was shown by the X-ray, and sometimes quite easily determined by the palpating finger. On that account in our recent cases we have also made at least one drill hole through the bone and put a catgut suture through the bone to prevent any separation of the bony fragments themselves.

DR. ANDREWS (closing the discussion): The delay of operation with the hope of establishing immunity did not appeal to me *a priori* but after a discussion which was reprinted in the English journals I found that Mansell, Moullin and one or two others of the best men in England agreed, and their statistics proved, that a greater number of infections in operations occurred on the day than in operations done after a slight period of reaction, say five or six days. The stopping of acute hæmorrhage, the beginning of absorption and the assumed immunity, or whatever factors there are present, seem to have been proved by statistics; so in badly contused knees I have followed that practice since reading that discussion, and have operated in from five to seven days.

DR. HERMAN L. KRETSCHMER read a paper by invitation entitled "The Value of the Shadowgraph Ureteric Catheter in the Diagnosis of Obscure Lesions of the Urinary Organs." (See p. 598.)

DISCUSSION

DR. MAX REICHMANN was asked to open the discussion. He said: The report of cases by Dr. Kretschmer, and especially the exhibition of his Roentgenograms, were very interesting to me.

I should like to call his attention to one point, namely, the use of the ureteral bougies made by Müller in Hamburg. These bougies are made from a mixture of rubber and lead, are therefore very opaque, and the danger of breaking is reduced to a minimum. The differential diagnosis between those shadows which appear so frequently in the pelvis, especially in persons over forty, and concrements in the ureters, is only possible by the use of ureteral bougies, and I think I was the first one who published a case in which this method of differentiation was used.

For the Roentgenographic diagnosis of a displaced kidney, I should prefer to use the method of Voelker and Lichtenberg, the so-called pyelography, that is, injection of a weak solution of protargol into the pelvis of the kidney by means of a ureteral catheter.

DR. WILLIAM T. BELFIELD: Dr. Kretschmer has indicated the different ways in which the shadowgraph catheter aids diagnosis. It is also true that this catheter has, at different times, led to a mistake in diagnosis. Thus the shadowgraph catheter has shown a stone in the course of the ureter, which on operation proved to be a concretion in the appendix. We can readily understand that there are other objects also than appendical concretions which could be overlaid by the catheter, causing a mistake in diagnosis. For instance, the seminal vesicle, lying in contact with the ureter at one point, might be the subject of a tuberculous concretion mistaken for a ureter stone. But with the more extensive use of this method of diagnosis these sources of error will gradually be eliminated. This method is certainly an addition to our diagnostic resources. This method dates back beyond 1901 by the way, having been used by Tilden Brown, of New York, in 1898, and by Fenwick of London about the same time.

DR. ARTHUR DEAN BEVAN: I quite agree with Dr. Kretschmer that this means of diagnosis is a very important one, and I know that in half a dozen cases in my work it has been of very great service. It is indispensable. I operated yesterday on a case which illustrated this very well. The patient was a man, forty years of age, who had a very severe pain on the left side. He was seen by a very competent general practitioner, who called in a surgeon. On examination it was found that the man had a lump on the left side of the abdomen; some temperature; the urine was quite normal; the possibility of some kidney lesion was canvassed, but was excluded because of the fact the urine was found normal. An operation was made in the middle line in front. A large retroperitoneal abscess was found and drained up high above the umbilicus. This continued to excrete pus and urine for some time. That case could have been

cleaned up with the ureteral catheter and with the shadowgraph catheter, as it proved to be a case of stone obstructing the pelvis of the kidney, with resulting pyonephrosis.

I regard this work as being very much in the same line as X-ray work, and that it should be in the hands of some man who is an expert in the work, and who is devoting his entire time, or a large amount of his time, to it. I do not think any of us who are in general surgery, and who are so tied hand and foot by the many problems that confront us in general work, are as competent to do good catheterization of the kidneys or ureters as are the men who are devoting their time to this work. On that account, I believe it will remain and should remain largely in the hands of experts.

One thing I should say in regard to the two cases which Dr. Kretschmer reported as coming from my service, and that is a word in regard to the technique. I think the technique followed in both cases of misplaced kidney and the one in which the stone was in the ureter, is a desirable operative technique in the majority of cases, and that is a muscle-splitting incision very much like an appendix incision in which the perineum is not divided, and in which the muscle-splitting is carried well to the middle line, this being done by blunt tearing and separation of the fibres of the muscles without any incision so that, for instance, the sheath of the rectus is split practically to the middle line. You know below the umbilicus or a little below it the three abdominal muscles unite and form a single layer in front of the rectus and in most of these cases of stone in the ureter the incision should be made, as a rule, below the umbilicus so that it is readily split as far as the median line and a huge opening can be obtained in this way without making the oblique incision which is usually favored by the Germans, and by stripping the peritoneum to one side one can readily expose the ureter over its entire course, except that portion of it below the bladder, and the one point I should like to emphasize in technique is this: that it is a good plan to leave the catheter *in situ* at the time of the operation in these operations for stone in the ureter, as you can find it readily with a fused wire in it. You can pick the ureter up on a couple of hooks so that the ureter stands out in the incision with the wire in place, and it is much easier to incise the ureter, remove the stone with the wire in position, and make closure of the ureter with the wire still in place. It adds a good deal to the ease of the operation. In removing a stone from the displaced kidney in front of the promontory of the sacrum we find no difficulty by the same muscle-splitting incision in reaching the stone and removing it. We were able to do here a simple pyelotomy.

One word in regard to the technique for the removal of stones low down in the ureter to the base of the bladder, and that is this: I am rather inclined to think that in many cases these can be operated on much better through the perineum. Recently we have had a satisfactory case in which a stone of fair size was in the lower end of the ureter, right under the bladder. We made the old-fashioned left lateral lithotomy incision except we did not cut into, but down to, the prostate, and then by blunt dissection followed along the prostate and seminal vesicles to the ureter, where we could feel the stone by palpation, nick the ureter over the stone with a pair of scissors, which was closed, and then stretch the opening with a pair of artery forceps and remove the stone in this way.

In regard to the bodies which we find so frequently in the pelvis, there has been a good deal of dispute. There is no question whatever in my mind but what in almost all cases they are centers of ossification in the pelvic ligaments. A few well authenticated cases have been reported where these bodies were phleboliths, but most of them are calcareous deposits found in veins and glands. The constant bodies we find at the tip of the spine and ischium are almost invariably centers of ossification in the pelvic ligaments. They do not occur in children. They do not occur until adult life, and they are quite common in the aged. Whether we can demonstrate then in all cases or not is a question, but the bodies we find so constantly are not phleboliths. Recently there have been reported several well authenticated cases where there were calcareous deposit in veins, but that I am quite satisfied is the exception and not the rule.

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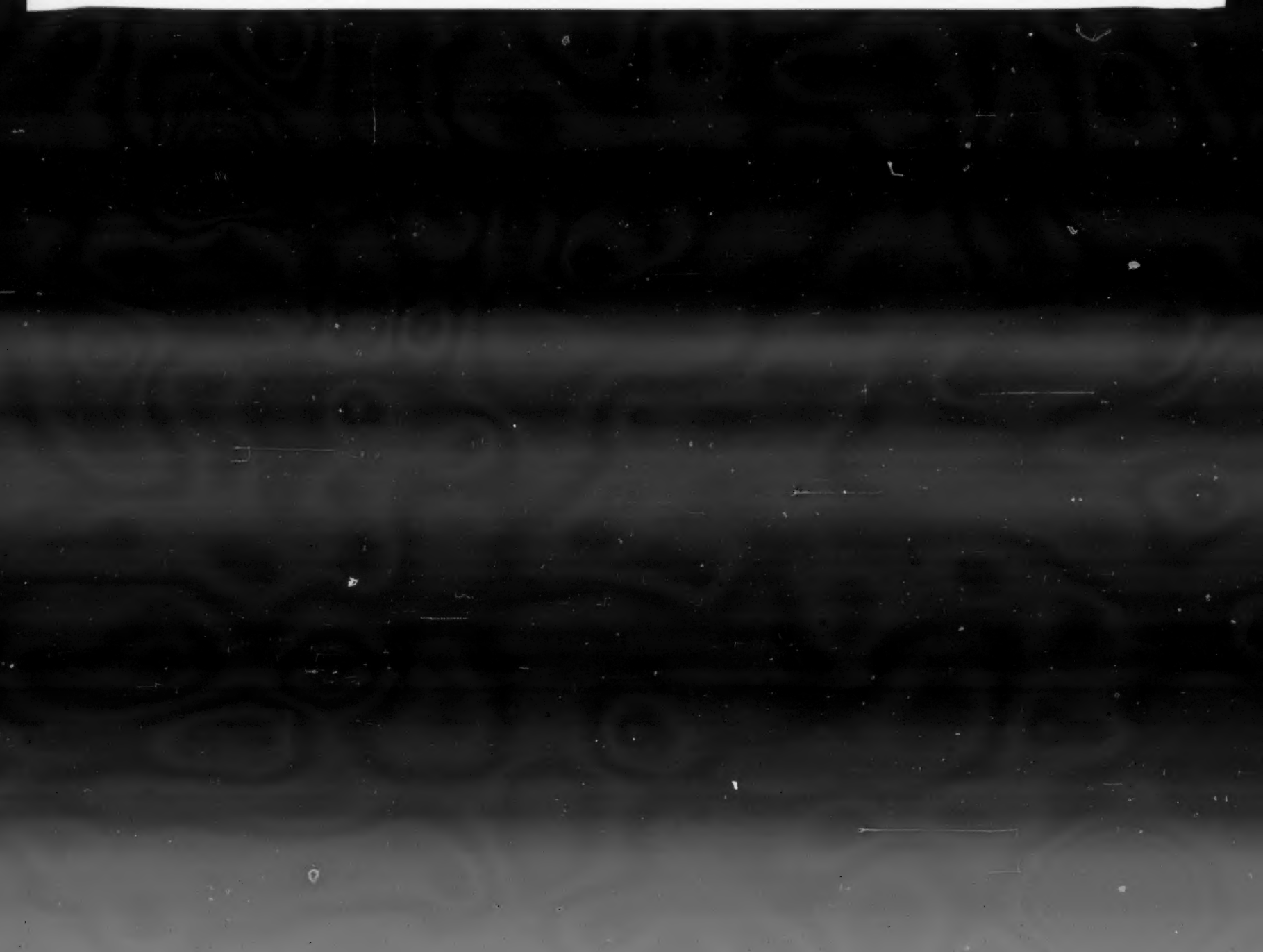

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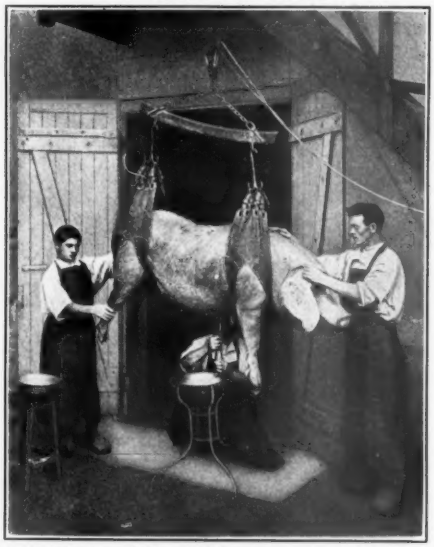

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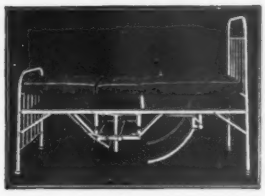
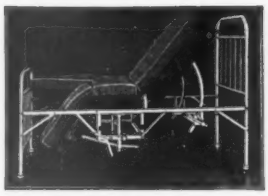
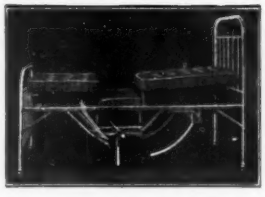

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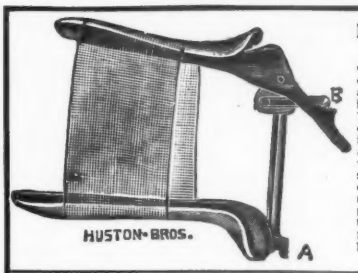

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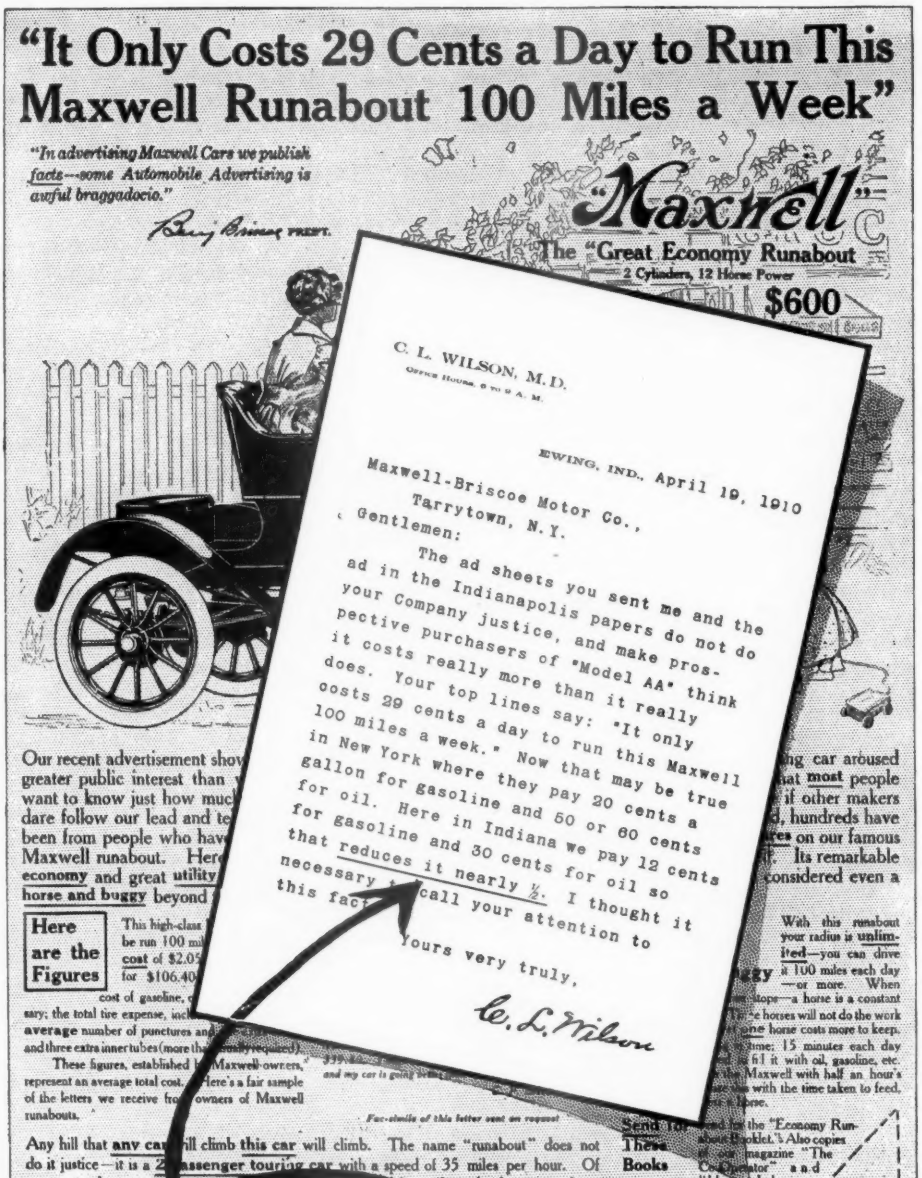
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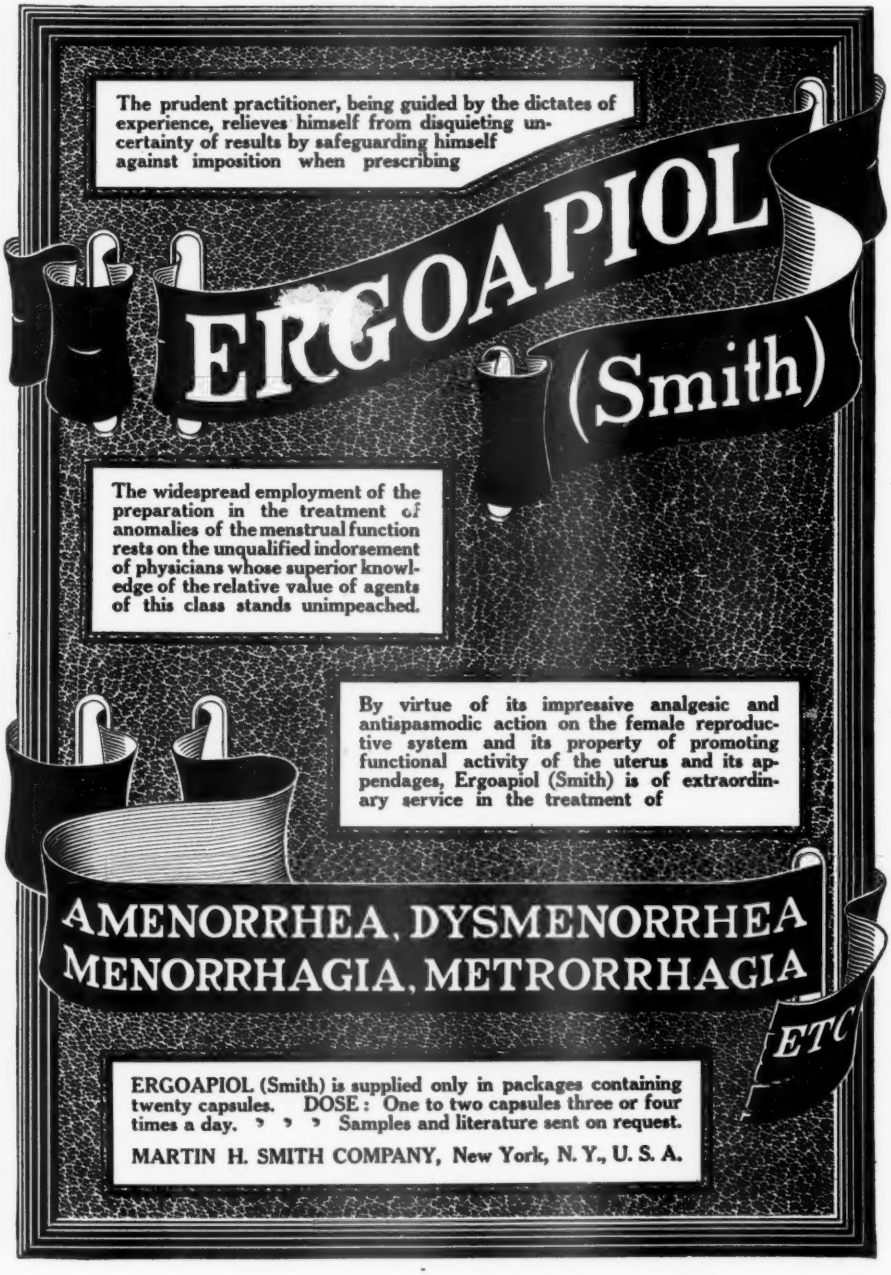
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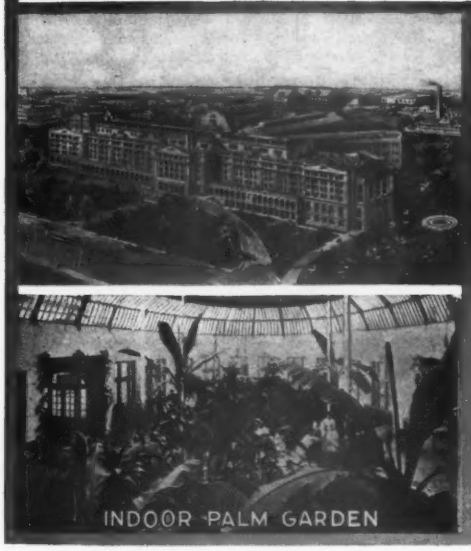

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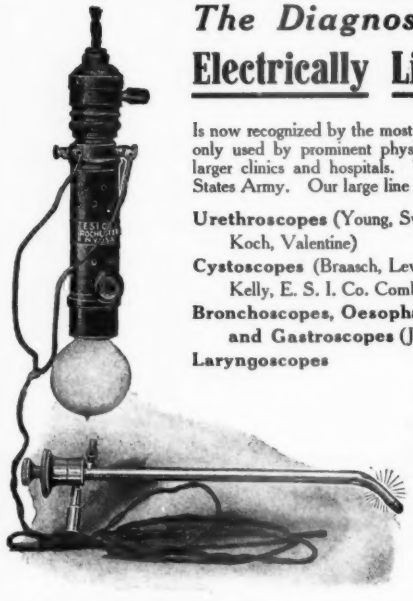

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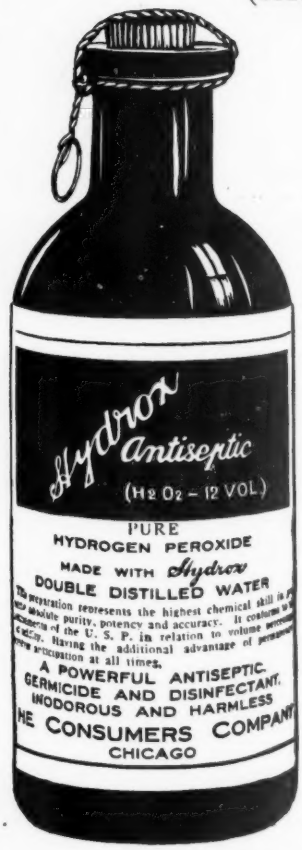

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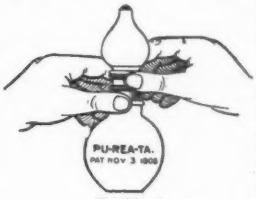

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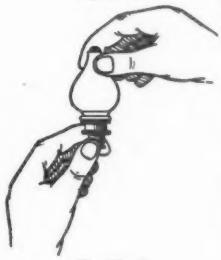

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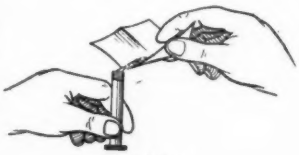

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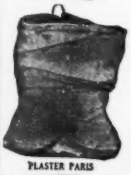
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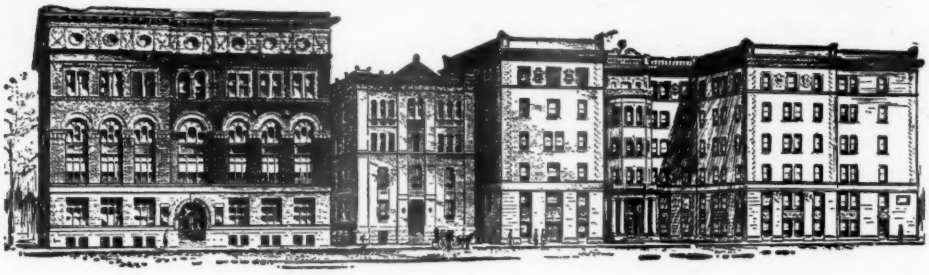

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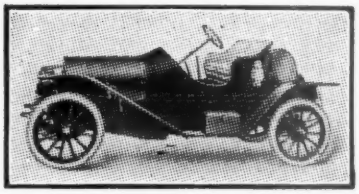

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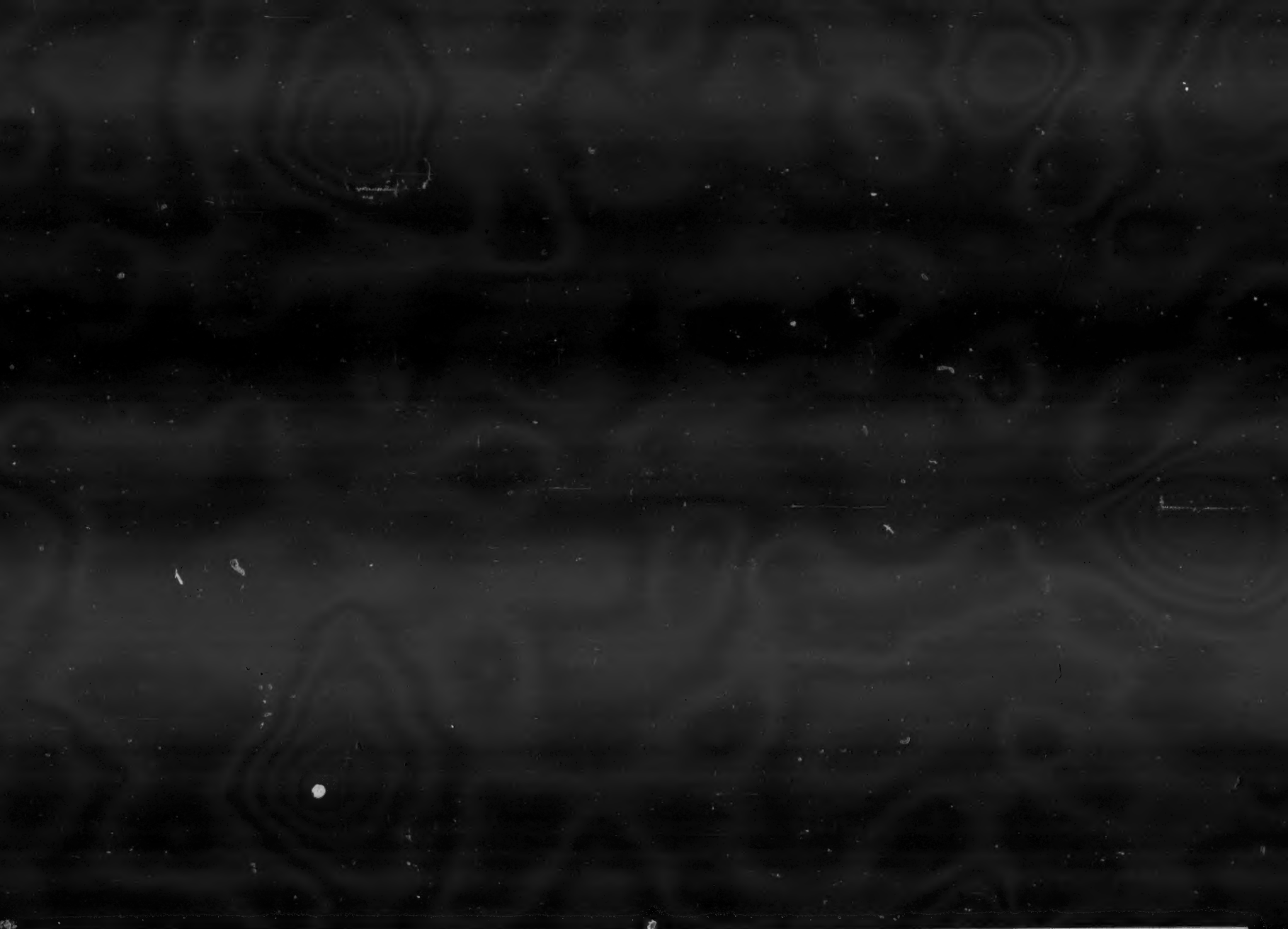

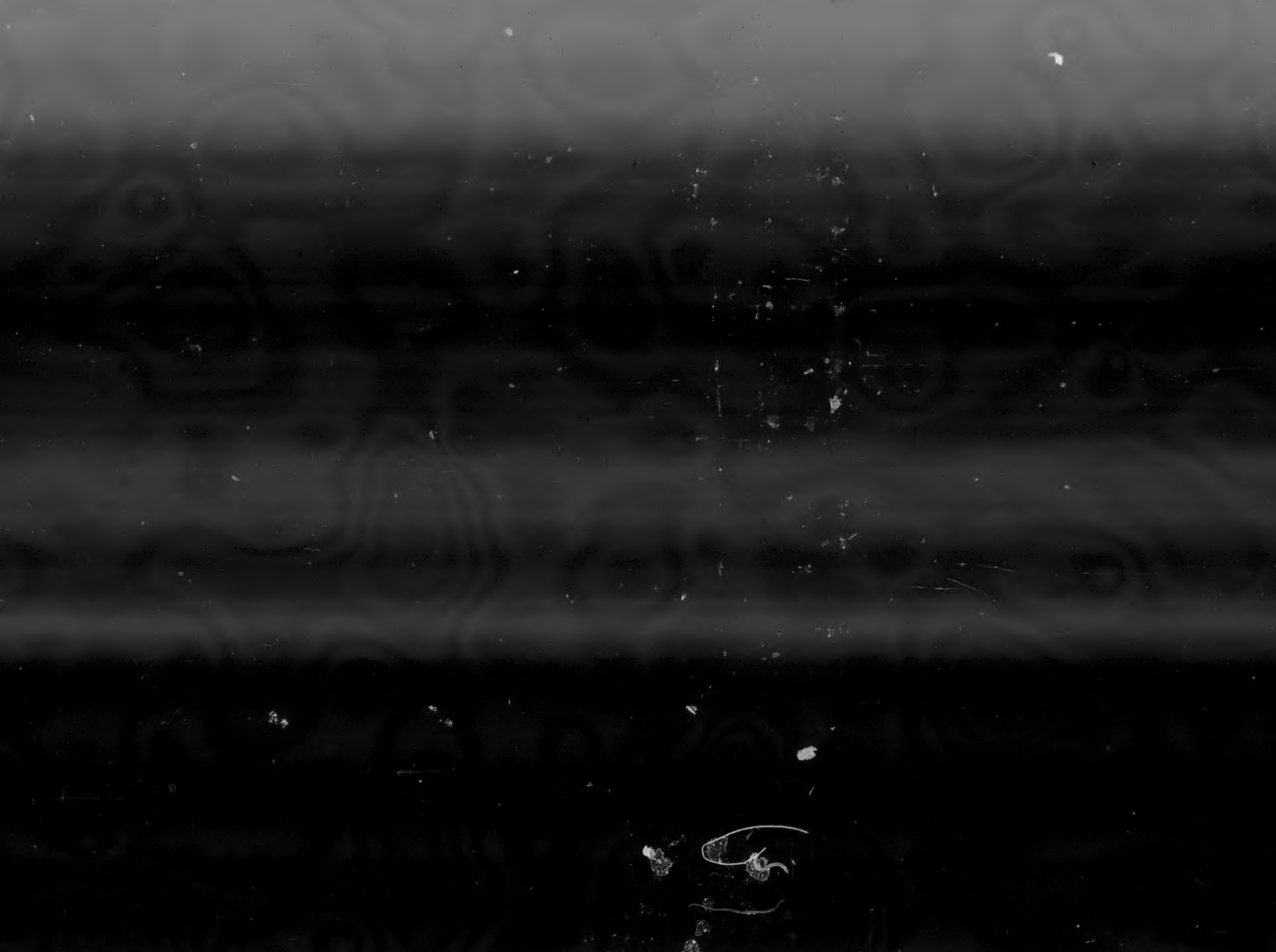

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